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AIR-DRIVEN TOOLS AND SELF-PROPELLED COMPRESSORS ARE INVALUABLE AIDS IN LAYING TRACK IN WINTERTIME.

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The Wonder Camp That "Jack" Built

Something About the Famous Picher Field, in Northeastern Oklahoma, Which is Now the World's Greatest Producer of Zinc

By ROBERT G. SKERRETT

WITHIN an area twelve miles square—extending northward from Miami, Okla., to Baxter Springs, Kans.—are situated deposits of lead and zinc that have yielded in the last eight years a total of more than $200,000,000 worth of these essential metals.

The story of the Miami-Picher District, as this tract is known, and especially the story of the Picher section of the district, is one of the romances of modern mining and is another amazing example of how the helpfully unexpected happens when the need of it is sometimes most pressing.

Ore was discovered in the neighborhood of Miami in 1905, but little was done in the way of development before 1908. Successful milling was greatly hampered by the presence of an asphaltic material, which made it very difficult to save the concentrates on a paying scale. Matters were not improved until mining operations were carried sufficiently deeper to escape the troublesome carbonaceous substance.

For a good many years previously, lead and zinc were mined in the southwestern section of Missouri in the neighborhood of Joplin and Webb City, where the deposits of these minerals lay at comparatively shallow depths with the ore bodies disposed horizontally in sheet-like formations. Even though the zinc content averaged only about 3 per cent.—being much lower in this respect than deposits elsewhere in the United States—still mining paid by reason of the comparative ease with which the metal could be separated from the gangue and a concentration effected in the mills that gave 58 per cent. in zinc, or even better. The mines of Missouri held first rank in the production of zinc for a goodly while, and the Joplin-Webb City District retained this position until it was surpassed in 1918 by the output of the mines in near-by Oklahoma.

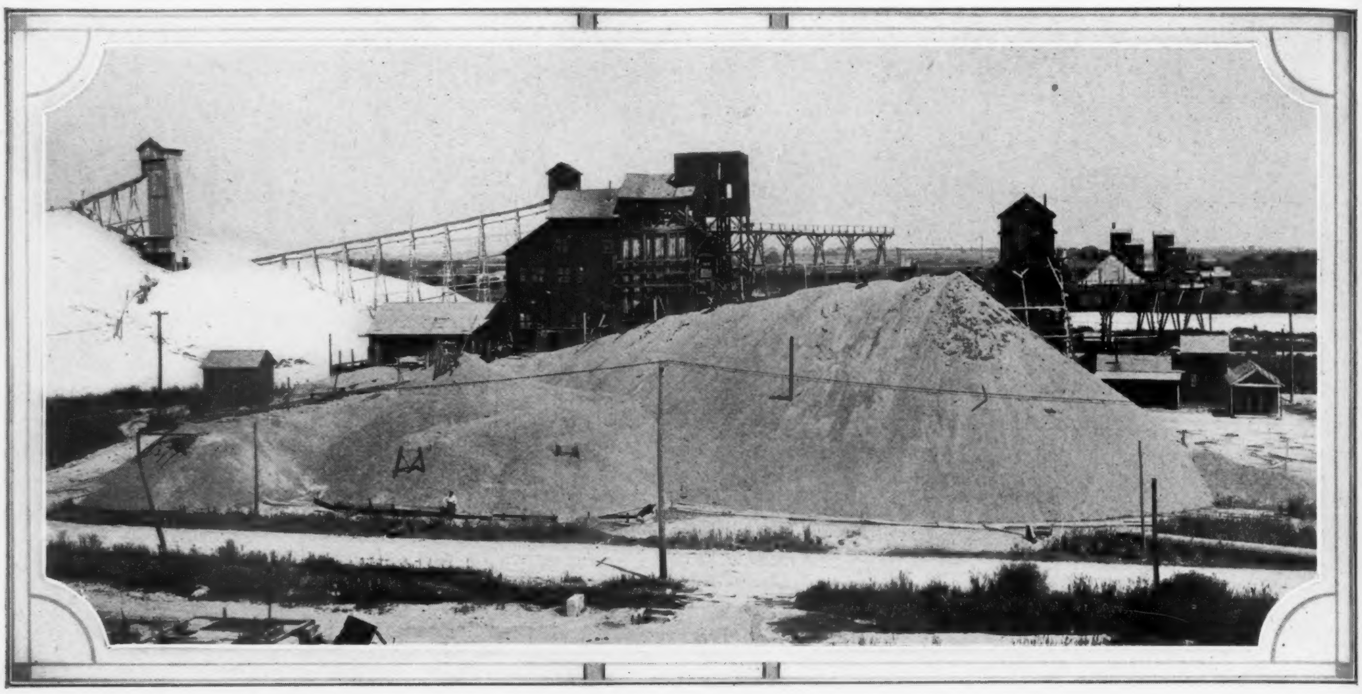
With the outbreak of hostilities in 1914, the Entente Allies were forced to look to the United States to satisfy their sudden and greatly increased demand for zinc for war uses; and early in 1915 it became plain that we could not meet this demand unless other domestic deposits were made available. This brings us to the spectacular origin and the development of the great Pitcher Camp—today the largest and the richest of the world's producers of zinc.

HOW much do you know about zinc and the ever-increasing ways the metal serves us? Are you at all familiar with the domestic sources from which we draw our supplies of zinc? And do you know that the very richest zinc mines in this country lie within a comparatively small area which, ten years ago, was open prairie land of relatively little market value? The accompanying article deals in the main with the Miami-Picher mining district of Oklahoma and Kansas, where Nature has stored vast quantities of lead and zinc and from which man has withdrawn in the last eight years mineral wealth to the value of more than $200,000,000.

The discovery of zinc in the Picher field was the climax of discouraging exploratory work having for its object the possible discovery of lead in that area. Churn drills then as now were employed for that purpose, and only shallow holes were drilled because experience in the near-by Joplin-Webb City territory had shown the lead-bearing deposits to lie at depths of considerably less than 200 feet. Because of the unpromising results attending the sinking of the holes in the region where Picher now flourishes, some of the lessees started to cancel their leases of the Indian lands and to abandon further search there. This brings us to the point where a mishap blazed the way to unsuspected riches.

In moving away one of the drill rigs during this exodus, the outfit got stuck in the mud—this was at the beginning of winter, and the crew decided to stand by the equipment until the coming of spring should make it possible for them to withdraw the rig. With time hanging heavy on their hands, the men sought action by resuming drilling; and they continued their work until they had penetrated deeper than was the usual practice. Then, to their great surprise, they were rewarded one day by making an amazingly rich strike. The results were so different from those obtained before that the owners of the lease were outspokenly skeptical when told of the find; and it took a lot of talking to convince them that the hole had not been "salted." The zinc content was several times richer than was the case with the ore bodies found in neighboring Missouri.

The hole that made the memorable strike was the 401st hole drilled during the exploratory campaign, and it was sunk on the property of a Quapaw Indian named Crawfish. As a consequence, that easy-going aborigine shortly thereafter became affluent, as have other of his fellow Government wards. The famous Crawfish Mine was the logical outcome of the sinking of that fateful hole in 1912; and the town of Picher began to develop on the open prairie within the next three years. Today, Picher has a population of 15,000; and within the Picher District are now actively engaged fully 7,500 miners. Almost without exception, these men are native-born Americans and a fine-looking lot of workers.



Webber mill in the Picher Camp. In the foreground is a pile of zinc concentrate or "jack" valued at $1,500,000.

Picher is a bustling place, and its citizenry take a pardonable pride in what has been achieved there in so brief a span.

Just how much good fortune had to do with the discovery on the Crawfish property can best be realized when it is borne in mind that the geological conditions there differ widely from those that prevail in the older Joplin-Webb City territory. In the Missouri district the ore bodies occupy more or less extensive horizontal areas, and the mineralized mass is fairly uniform throughout each individual "sheet." That is to say, a number of test holes sunk through a given ore body will show fairly similar characteristics. In the Picher field, on the other hand, the ore bodies exist in so-called "runs," and a difference of only a few feet between holes may reveal a richly mineralized area or rock containing no metallic values whatever. Before describing mining methods in the Picher field it might be advisable to consider what happened in that region many thousands of years ago that ultimately brought about the upbuilding of the zinc-lead formations which have made Picher world famous.

The rock in which the lead and zinc ores lie belong to the Mississippian age—a period that occurred 65,000,000 years ago. For some reason or other—why, no one will ever be able to tell—that part of the earth's crust cracked in a generally northwesterly direction, producing what the geologists have since named the Miami fault. Into this cleft or series of clefts were deposited cherty limestones; and still later, lead-and-zinc-ore-bearing solutions flowed into the fissures of this fractured mass and the minerals were crystallized out of solution. Because the zinc was more soluble than the lead, the lead was deposited at higher levels while the zinc was carried in solution to lower depths in the enveloping rock. Thus

Panorama of a section of the Picher Camp on the north side of the town as it is today.

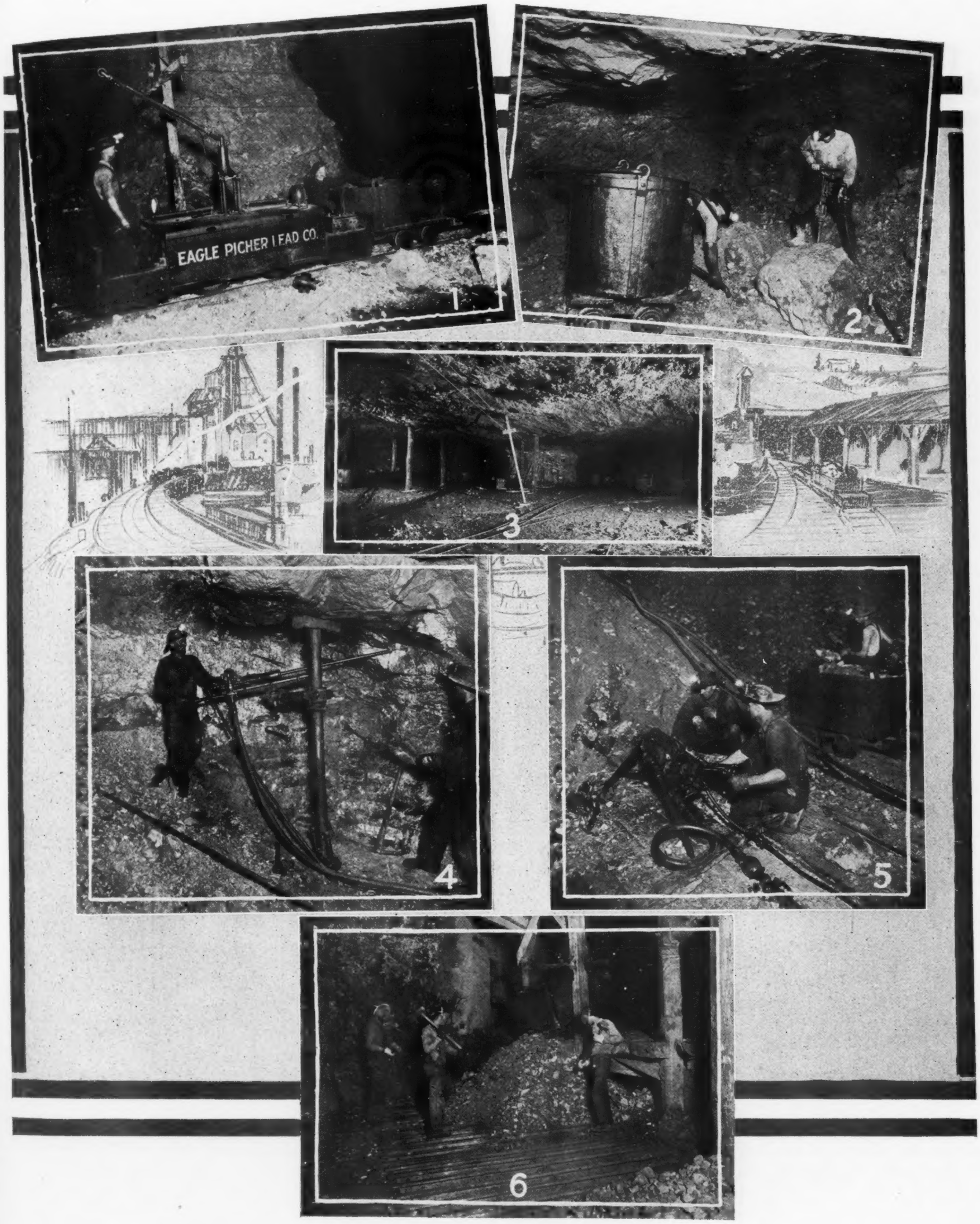


Fig. 1—Trolley locomotives do much of the hauling in the large mines.
Fig. 2—"Jackhamers" are generally used to drill pop holes in large pieces of rock.
Fig. 3—Room-and-pillar method of mining is commonly employed in the Picher field.
Fig. 4—"Leyner" drifter drilling a heading round of 11-foot holes.
Fig. 5—"Leyner" drifter drilling a 21-foot stope hole under a 70-foot heading.
Fig. 6—"Screen apes" breaking up over-size rock being fed to an underground ore hopper.

watercourses became filled in time with these minerals in varying combinations or degrees of predominance; and what was once an aggregation of broken rock became a compact and even a solidly cemented mass. Some idea of the changes wrought and the forces at work during this period of transformation can be gathered from the established fact that the region was once covered by great beds of coal that were subsequently worn away by erosion.

Every now and then, someone in a critical mood finds fault with the practices pursued in the Picher District and thereabouts in the mining and the milling of the lead-zinc ores; and by way of confirming the wisdom of these practices, let us quote the mature judgment of certain experts of the United States Bureau of Mines: "The methods used in mining and milling ores in this district may seem crude and wasteful to one accustomed to the more elaborate methods employed in other mining districts, but careful study shows that they are well adapted to the existing conditions. The ore bodies vary widely in shape, richness, and extent, and it is difficult to calculate the probable yield of an ore body from drill-hole records. Frequently, however, failure or loss on investment has been due more to insufficient drilling and development work previous to erecting the concentrating plant than to variations of the ore body or to poor management. The generally small size and irregular shape of the ore bodies have not encouraged the building of large, expensive plants. Economy in first cost rather than a higher saving by more elaborate and efficient equipment has been the prevailing consideration."

The correctness of a policy of this sort has been proved in numerous instances, and any departure from it is likely to entail either loss or the making of little more than actual expenses. Furthermore, the lands in the neighborhood of Picher are mostly owned by Indians, and the leasing of these lands is under Government control and with an eye single to the interests of the wards of the nation. These leases may be sublet one or more times before the operating company comes into possession of the property, and all this involves the payment on the part of the company of cumulative royalties. This overhead is a fixed and may be a heavy charge which tends—in combination with the uncertain extent of the ore bodies and their character—to restrict outlays for mining and milling equipment. Anything in the way of a pretentious mill may turn out to be a veritable gamble with the odds against commensurate returns.

The ore bodies in the Picher Camp lie at an average depth of 225 feet, but some of the workings are at a depth of 380 feet. Mining is carried on by what is known as the room-and-pillar method in the hard-ground area which prevails in the section. In hard ground, timbering is not required; but supporting pillars of rock, representing about 12 per cent of the area cut, are left standing at suitable intervals—depending upon the character of the ore body and on the height of the face mined, which may be as much as 70 feet. A system of underhand stoping is employed for the removal of the extensive bench; and at the top of the bench the advance is made by a 7-foot heading—a round being drilled usually to a depth of 10 feet. According to the height of the stope, splitter holes are drilled at one or more levels and a line of stope holes are drilled at the bottom of the stope to a depth ranging from 16 to 20 feet. Both the splitter and the stope holes are "squibbed" or chambered by preliminary charges before they are loaded for final firing. In the mines at Picher both the heading and the other holes are wet drilled with drifters, and large pieces of blasted rock are pop-holed with "Jackhamers." Despite the use of powerful drifters the rock is difficult to drill, and often more time is spent in withdrawing the steels than in drilling the holes. It is said that a drill runner does well if he manages to drive 40 feet of hole in the

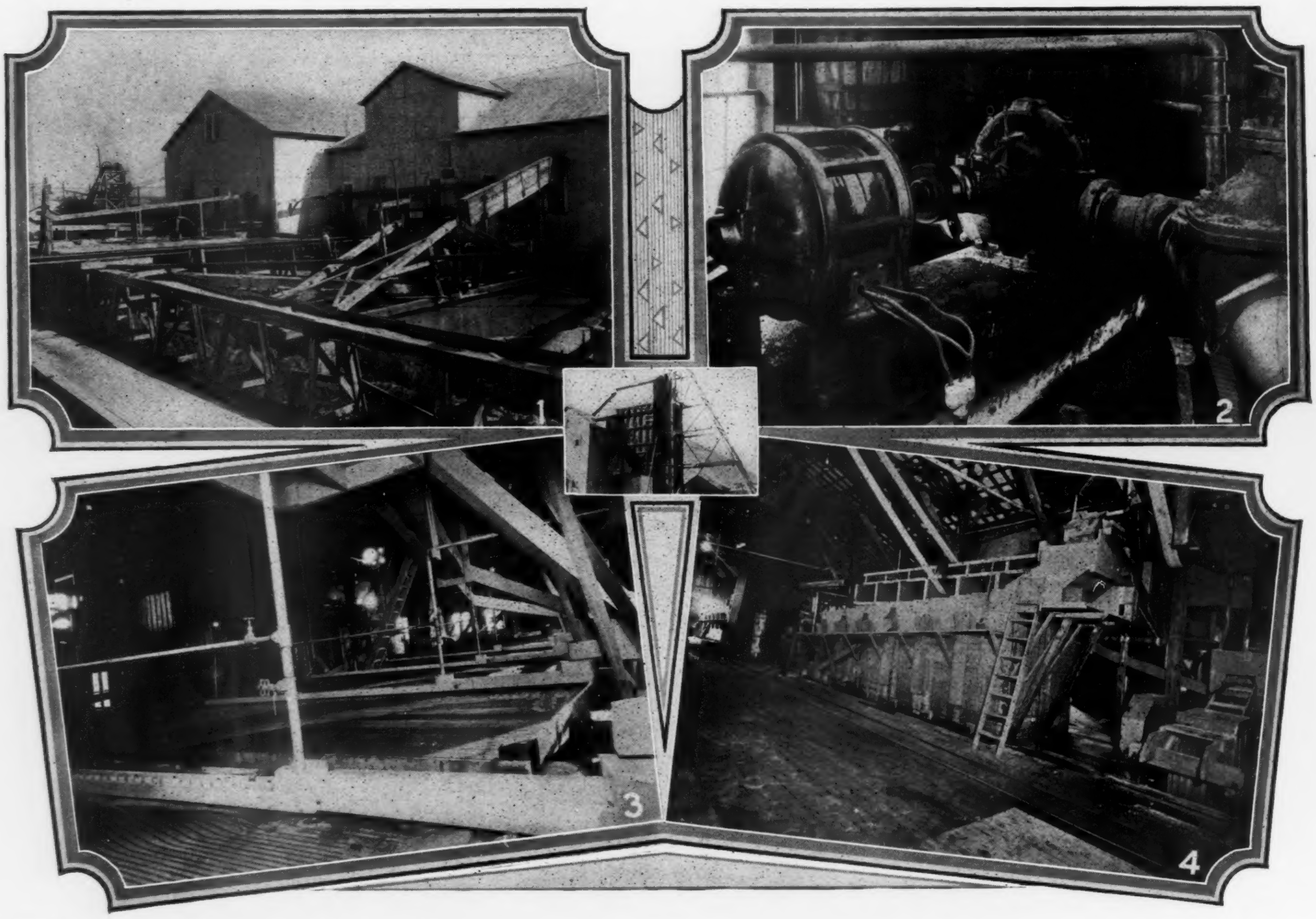


Fig. 1—Sludge mill at one of the big mines.
Fig. 2—Cameron pumping equipment in one of the largest and latest of the mills at Picher.
Fig. 3—Sludge department of a new mill where one of the operations for the recovery of metallic values is carried out.
Fig. 4—Jig department of a typically modern mill where the first step is taken to separate the metal in the crushed ore from the associate gangue.

course of a working day of eight hours. The rock is hard, and has interposed pockets which give lots of trouble to the driller. The fractured formation of the rock leads to its spawling, and these fragments get back of the bit and bind it. The drill runner has to be an expert and able to judge by the "feel" just what are the unseen conditions with which he is dealing more or less deeply in the rock.

No set mining rules hold in the Picher District. The operations are so directed that they follow the ore wherever the mineralized body leads; and the work is continued until the run is exhausted. The rich faces of one day may peter out in a few days; and this is understandable in view of the geological conditions under which the deposits were formed. The average horizontal depth of the ore body is about 40 feet, and the vertical extent may be nearly twice that, with workings carried on at three levels—the muck being hauled by mules at the topmost level and moved by trolley locomotives at the two lower levels. A paying seam may stop abruptly at one level while operations on other seams may be pursued profitably above or below that level. Experience has shown that even though a prospecting hole may reveal only poor ore, still work below ground may strike very rich ore within three or four feet of the line of the unpromising hole. To the Picher miner all ore is "dirt"; and zinc concentrate produced at the mill is called "jack."

In the course of an 8-hour day a large mine will yield nearly 1,200 tons of rock; and this rock may be delivered, through a large concrete-lined shaft 50-odd feet deep, to an underground hopper having a capacity of 1,000 tons. From this hopper the rock is fed through a number of chute gates into 3-ton counterbalanced skips by which it is hoisted to the surface. The rock, when handled in this way, is fed into the shaft through a screen or grid made up of 80-pound rails spaced ten inches apart. Pieces too large to pass between the rails are broken up with sledges by "screen apes"—workers whose faces are protected from flying fragments by means of wire masks.

In most of the mines, the ore is raised to the surface by cans or large cylindrical steel buckets capable of holding anywhere from 1,250 to 1,650 pounds of rock at a load. The "tub hooker" is the man at the bottom of the shaft who hooks the loaded cans to the cable and unhooks the empties upon their return for refilling. No signals are exchanged between the tub hooker and the hoist man above, and yet the two of them coördinate their respective functions to a really wonderful degree—slips in either case occurring but rarely. What this means can better be realized when it is understood that the cans go up and down hour in and hour out and make a round trip of possibly 500 feet or more in less than half a minute. The usual procedure is to place a mill between two shafts set 300 feet apart, and these shafts —which are approximately 5½ feet square— are the routes by which the ore is sent up to the mill for treatment. In passing, let us mention that the man in charge of the shovelers who fill the cans is called a "cokey herder"; and the man that pushes a muck car is known

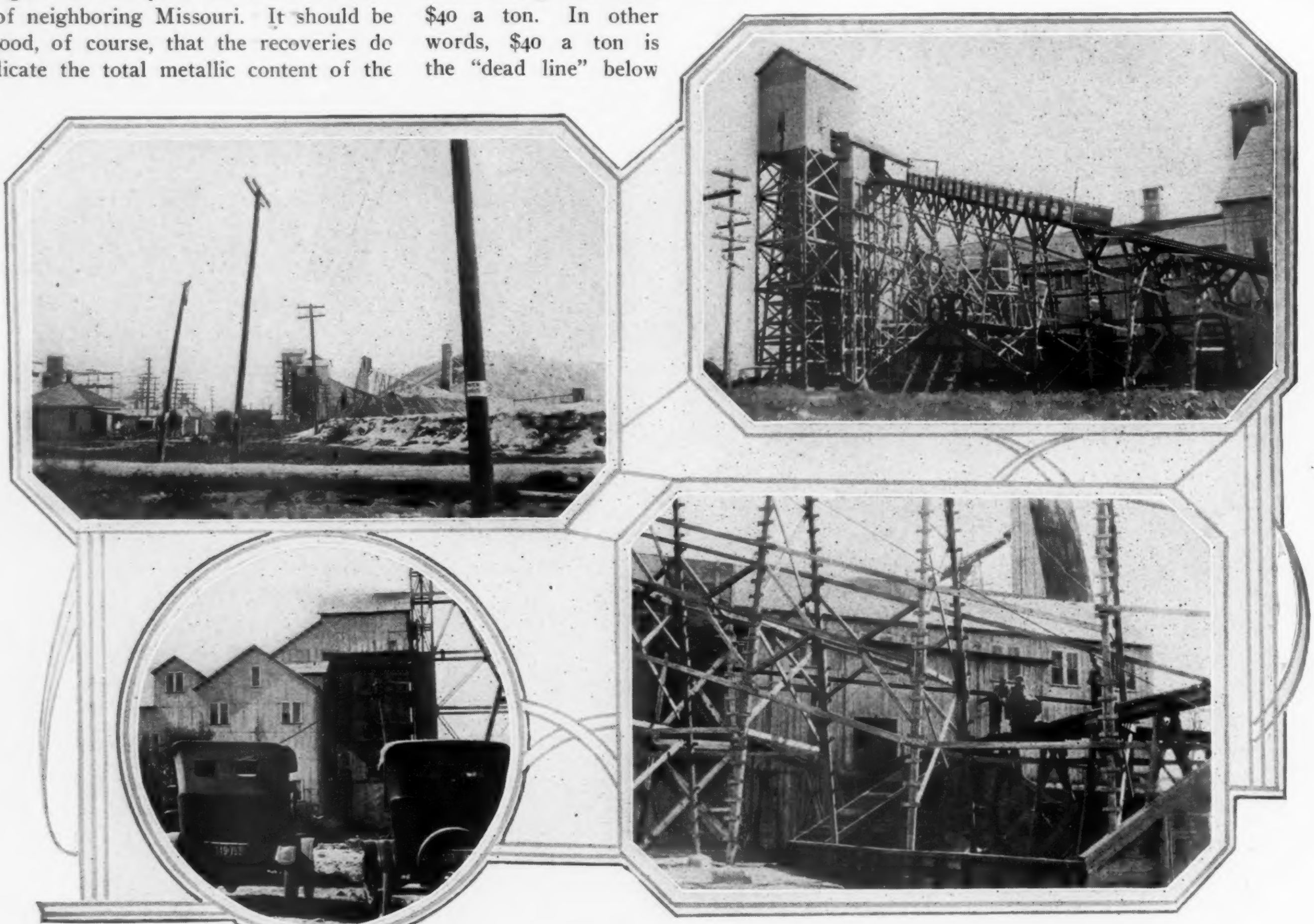
Circle—Drill doctor at work in an underground repair shop.
Right—Underground drill-sharpening plant equipped with a "Leyner" sharpener and a drill punch.
Bottom—Air-driven "Little Tugger" hoist handling drill steels and timbers between upper and lower levels.

as a "skinner" or is sometimes spoken of as a "mule."

Sphalerite or blende is the form in which zinc is usually found in the district; and galena—a lead sulphide—is the most important lead ore recovered from the ores mined in the Picher field. Calcite, locally dubbed "tiff," is one of the most common of the minerals associated with the ores. In the Picher field the total metallic recoveries average 6.98 per cent.—made up of 1.19 per cent. of lead and 5.79 per cent. of zinc. In the Baxter Springs District, in neighboring Kansas, the recoveries average 1.27 per cent. lead and 5.82 per cent. zinc. These recoveries of zinc are much higher than they have ever been in the mines of neighboring Missouri. It should be understood, of course, that the recoveries do not indicate the total metallic content of the ores—a considerable percentage of the metallic values being lost by reason of the milling methods generally employed in the district.

Compressed air is carried from the aboveground compressor plants down into the mines by 4-inch lines which deliver the air to receivers underground. From the receivers, 3-inch lines convey the air to the first "air head," and thence the distributing system takes the air to a secondary head through 2-inch piping to points as close to the headings as conditions will permit. From there on the piping is of 1-inch diameter, and hose connections link these feeders with the drills. The water lines for the drills are of 2-inch piping all the way to the secondary heading, and from there on they are reduced to 1-inch. In the Picher District compressed air is used not only for operating rock drills but for driving steam hoists, "Little Tugger" hoists, drainage pumps, steel sharpeners, riveting hammers, blacksmith forges, and air lifts for the raising of water. Compressed air is also used to function hopper gates, to clean electric motors, and to spray-paint buildings and to creosote timbers.

Before touching upon the work in the mills, let it be understood that recoveries average between 8 and 10 per cent. of combined lead and zinc. That is to say, if the recovery be 8 per cent. it is necessary that 12½ tons of ore be treated by the mill to produce one ton of concentrates; and zinc cannot be mined and milled at a profit if the marketable concentrates bring less than $40 a ton. In other words, $40 a ton is the "dead line" below which the operator cannot work and make money. Visible evidence of the quantities of rock that must be drilled and blasted loose underground are seen on every hand in the Picher District in the form of towering or accumulating piles of dazzling white rock or tailings from the mills. These tailings are locally called "chat"—a perversion of a term used elsewhere among the mining fraternity to mean a mixture of rock and mineral not yet treated by the mill. Between 1917 and 1923, inclusive, substantially 39,000,000 tons of rock were brought to the surface in the Picher field!



Snapshots of some of the mills and dumps in the Picher District.

The object of the work in the mills is to separate as far as possible the metallic values from the enveloping gangue or rock. Broadly stated, this is effected by gravity concentration in which large quantities of water play a prime part in segregating the heavier metals from the gangue. The specific gravities of the three principal substances involved are as follows: gangue rock, 2; zinc, 4; and lead, 7. During their passage through the jigs, these materials precipitate in the water-filled compartments in more or less well-defined strata which facilitate both concentration and separation. The jigmen display wonderful skill in supplementing the mechanical work of the machines.

The mines and the mills in the Picher District differ in their activities agreeably to the nature of the ore produced and handled by them. That is to say, some mines produce only lead, some only zinc, and some both of these metals in identical or differing degrees. Of two mines near together, for example, one may give a greater yield of lead while the neighboring one will be correspondingly richer in zinc. But, be this as it may, the procedure in the associate mills is pretty nearly alike in all these plants, save that in the best-equipped of the mills are installed flotation departments for the recovery of metal values from slimes which otherwise would be discharged untreated and classed as waste.

Without going into detail, it will probably answer our present purpose to say that the aim of the operating companies is to make as high a grade of concentrate as possible so as to command the best base price for their out-

This large up-to-date warehouse in Joplin makes it possible to supply promptly rock drills and other pneumatic equipment required in mining and milling the rich lead-zinc ores at Picher and at neighboring properties.

put. This has its drawbacks because it does not always insure the greatest practicable recovery of the zinc content of the rock. According to a report made some years ago by the United States Bureau of Mines: "The average percentage of zinc recovery is 60 to 70 per cent.; or, in other words, for every two tons of zinc concentrate produced one ton is lost." Happily, conditions have undoubtedly been materially bettered in this respect in some of the mills.

Concentration of the ore is usually effected by first putting the rock through crushers and then through rolls, which ultimately reduce the largest fragments to pieces that will pass through trommels or revolving sieves having holes 7/16 inch in diameter. After crushing and sizing, the material is delivered to jigs of the well-known Harz type, while the finer sands are treated on sand or slime tables to separate the more or less pulverized rock from the metallic particles. Most of the water used in the mills in the Picher District is impounded rain water; and, after allowing for periods of settling, it is run through the mill time after time.

In the case of some of the large and thoroughly up-to-date plants, the slimes are once more treated by flotation machines that separate the minute particles of lead and zinc from the muddy mixture. Soda ash and wood oil are added to the slime; and compressed air blown upward through this mixture produces a froth of large bubbles which bring to the surface with them the tiny bits of metal carried by the slime. The froth is skimmed off mechanically and dried by steam—after which the product goes to an ore bin. In this way, it is practicable to make a higher grade of zinc and of lead concentrates; and the additional work involved is amply justified by the higher price obtainable.

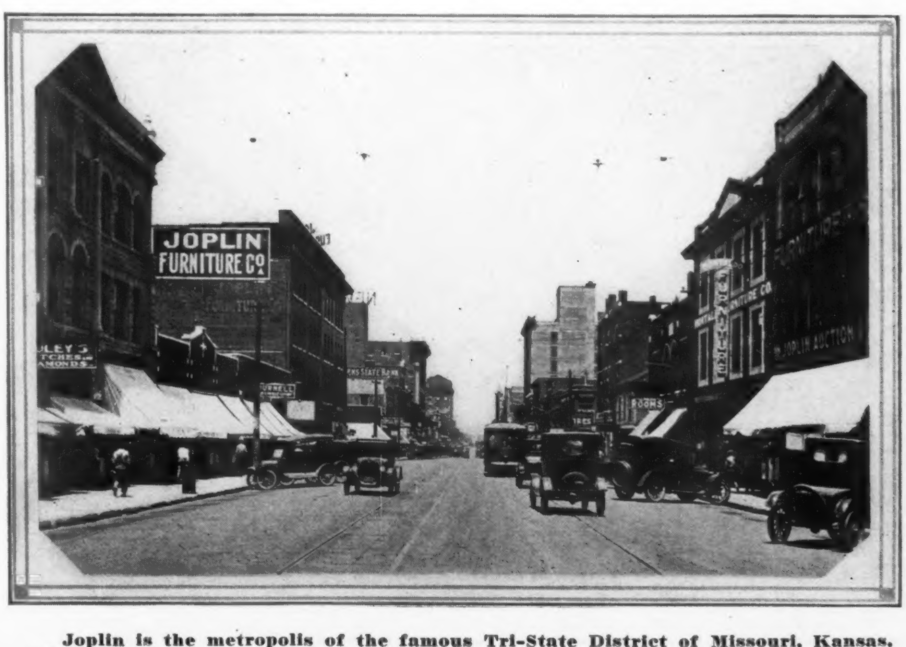
How the Picher Camp looked in 1915.

An interesting angle of the practices in the zinc-lead fields of the Tri-State District is the manner in which the concentrates are sold weekly to the agents of the refiners who smelt the ores. All these sales are made merely by verbal arrangement—there are no formal papers or written agreements relied upon, and yet, notwithstanding this seemingly unbusinesslike procedure, the parties seldom fail to live up to their obligations.

All told, 135 mines and about 158 concentrators are in active operation in the Tri-State region—the majority of these being in the subdivision embraced by the Miami-Picher District. In the course of a single week last year as much as 16,000 tons of "jack" was produced by the combined workings; and it is of national and even worldwide interest to approximate how long this richly mineralized part of the United States may be counted upon to yield lead and zinc in large quantities.

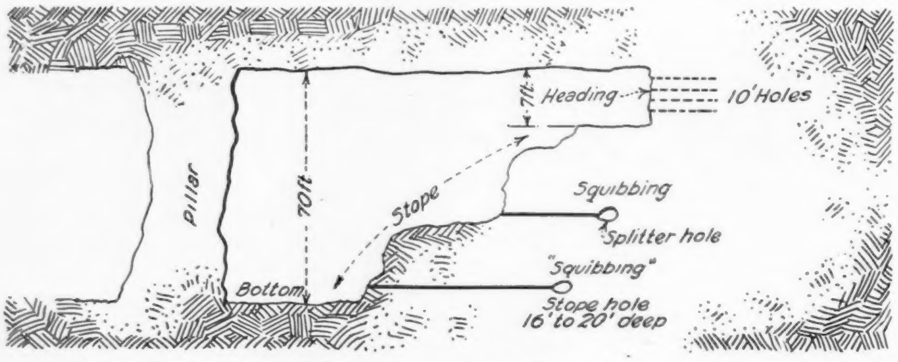
According to one of the experts of the Tri-State division of the American Zinc Institute, the district should be able to produce concentrates at the present rate for seven or eight years to come. This is based upon the assumption that 3,131,854 tons of concentrates may still be recovered from the proven mineralized area and that a possible 2,179,742 tons of concentrates may be obtained from the surrounding supposedly mineralized area—making a total reserve of 5,311,596 tons. A 40-acre tract will produce substantially 39,000 tons of concentrates; and at the present rate of working a 40-acre tract is being exhausted of its 6 per cent. estimated reserve every two and a half weeks.

Most of us are fairly conversant with the various uses to which lead is put, but relatively



Joplin is the metropolis of the famous Tri-State District of Missouri, Kansas, and Oklahoma in which lie the mines that are our largest producers of zinc.

few of us are acquainted with the ways in which zinc in one form or another is made to serve us. According to governmental figures, issued in 1923, as much as 45½ per cent. of the slab zinc consumed in this country is utilized in galvanizing iron and steel commodities so that they may be the better able to resist the corrosive action of the atmosphere. Fully 34 per cent. of our slab zinc goes into the making of brass, which is employed in innumerable ways; and nearly 11 per cent. of the slab zinc consumed annually is rolled into sheets which, in turn, are used for superior roofing, for spouting, for leaders, for architectural ornaments, for metal ceilings, for dry batteries, for plates for photo-engraving, for toys, etc., etc. The remainder, amounting to a little more than 9 per cent., has many commercial or industrial applications.



Longitudinal section of typical room-and-pillar method of mining in Miami-Picher District.

Zinc is utilized in dyeing and in the manufacture of dyes; in the recovery of gold and silver from cyanide solutions; in the compounding of paints; and in the vulcanizing of rubber. In fact, every automobile tire owes some of its desirable properties to zinc worked into the rubber compound. There are many other ways in which zinc in some form is applied to advantage. It is owing to its diversified and extensive field of service that zinc has become a metal of outstanding importance.

The development of the Miami-Picher District has been due to the enterprise and to the business acumen of a good many men, but space forbids the mention of the names of all of them, much as we should like to do so because of the credit rightly due them. However, it is commonly acknowledged that the pioneer exploratory work of Victor Rakowsky and the administrative skill of Arthur E. Bendelari have been especially conspicuous in helping to make the district what it is today.

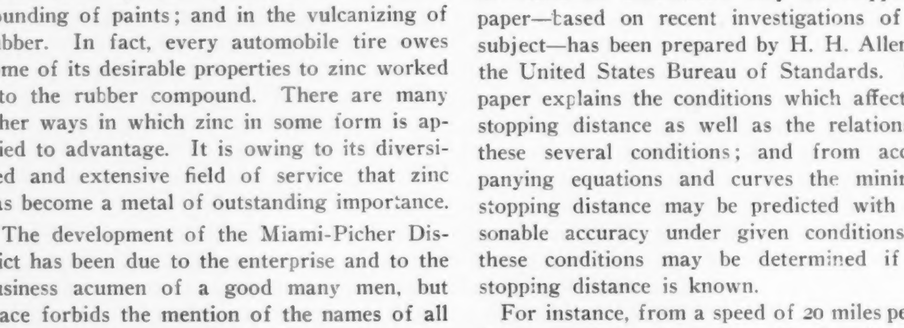
GOVERNMENT TESTS OF AUTOMOBILE BRAKES

OWING to the fact that many persons have an indefinite idea as to the number of feet in which an automobile may be stopped, a paper—based on recent investigations of the subject—has been prepared by H. H. Allen, of the United States Bureau of Standards. This paper explains the conditions which affect the stopping distance as well as the relations of these several conditions; and from accompanying equations and curves the minimum stopping distance may be predicted with reasonable accuracy under given conditions, or these conditions may be determined if the stopping distance is known.

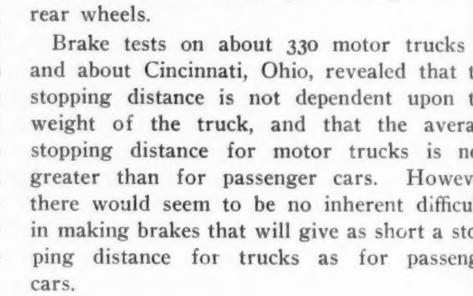
For instance, from a speed of 20 miles per hour, a small coupé—such as a Ford equipped with 2-wheel brakes—could not be stopped in less than 44 feet on a dry concrete road having a coefficient of traction of about 0.7. On the same road, and at the same speed, a large 7-passenger touring car with 2-wheel brakes could be stopped in 37 feet. With 4-wheel brakes either car could be stopped in about 20 feet. If the coefficient of traction is 1.0, as it might be on rough concrete, the car with 4-wheel brakes could be stopped in 14 feet.

The stopping distance is influenced by the coefficient of traction between the wheels and the road, and this in turn depends on the percentage of weight carried on the braked wheels. This is 100 per cent. in the case of 4-wheel brakes, while for 2-wheel brakes this percentage—and hence the stopping distance—is affected by the position of the car's center of gravity in relation to the wheel base. A short, high car tends to nose over when the brakes are applied, thus reducing the weight on the rear wheels.

Brake tests on about 330 motor trucks in and about Cincinnati, Ohio, revealed that the stopping distance is not dependent upon the weight of the truck, and that the average stopping distance for motor trucks is now greater than for passenger cars. However, there would seem to be no inherent difficulty in making brakes that will give as short a stopping distance for trucks as for passenger cars.



Composite map of the neighboring sections of Oklahoma and Kansas, popularly known as the Miami-Picher District, that have proved so rich in their deposits of zinc. The enveloping dark area is supposed to be mineralized, while the numerous small shaded areas lying within indicate proved and worked mineralized ground.



Prospecting is done with churn drills, and cuttings are sampled every five feet as the spud goes downward. Drilling costs about $1.25 a foot.

Compressed Air's Part in Wintertime Laying of Rails

By A. S. TAYLOR

IT IS a matter of general knowledge among railroad men that the air compressor has been especially adapted for service in connection with maintenance-of-way work. The well-informed are fully aware that air compressors of this description have been in use for some years for supplying the necessary motive energy for the driving of riveting hammers, drills, reamers, bolting machines, tie tampers, etc. These tools and their prime movers have been employed to advantage in the repair and the construction of bridges, and for the numerous other services that have to do with the diversified activities of the maintenance-of-way department of railroading.

SEASONAL limitations, which have heretofore kept men unemployed for months running, are among the most fruitful sources of industrial waste. The wage earner could, undoubtedly, make a good deal more and many undertakings would cost considerably less to carry out if the work could be spread over the whole year.

We offer here an example of what is being done by one great trunk-line railway to save money and to insure operative efficiency by doing track laying during a period of the year when such work is commonly considered impracticable. Success in this very suggestive departure is in no small part due to the employment of mobile compressors and air-driven tools.

Even so, there is a widespread impression among railroad men that air compressors of this type can be utilized only during certain seasons—in other words, that they can be used effectively only during the spring, summer, and early fall months. Such, however, is not the case; and the incorrectness of this conclusion has been strikingly demonstrated by the Maintenance-of-Way Department of the Lehigh Valley Railroad.

To appreciate what that road has accomplished in the way of a radical departure in practice, it should be pointed out that the territory through which the tracks of this progressive line run is what is termed a "heavy snow country," and winter storms are apt to be both frequent and severe. Therefore, there are no seasonal conditions that tend to favor wintertime work.

The Lehigh Valley Railroad has pursued for a goodly while a policy that has inspired the devising of one plan after another by which more and more work could be accomplished per man employed without overtaxing the worker. Much ingenuity has been displayed to this end during the past fifteen years or so. It will be recalled that the line was among the first to adopt the tie tamper and to utilize locomotive cranes and other mechanical equipment for a wide range of services.

For a number of years past, the Lehigh Valley Railroad has made it a practice to do all its rail laying during the winter months—thereby reducing its summer force and effecting very substantial economies. This procedure puts the road far ahead when it comes to handling its regular work upon the arrival of spring. As an aid to winter track laying the road has made effective use of its portable air compressors, and has thus found a way to employ them at a season when ordinarily they would be idle.

A 12-tool, self-propelled compressor outfit furnishing air to operate pneumatic bolt tighteners.

The compressors have been relied upon to furnish air to operate pneumatic wrenches in unbolting old track and in bolting up new track, and also to drive drills in drilling both bolt holes and bond-wire holes in rails. Aside from speeding up rail laying, and incidentally cutting down the size of the gangs required by substituting machine work for hand work, the practice has made it possible for the company to get more service out of this pneumatic equipment and thus to realize a greater return upon its investment.

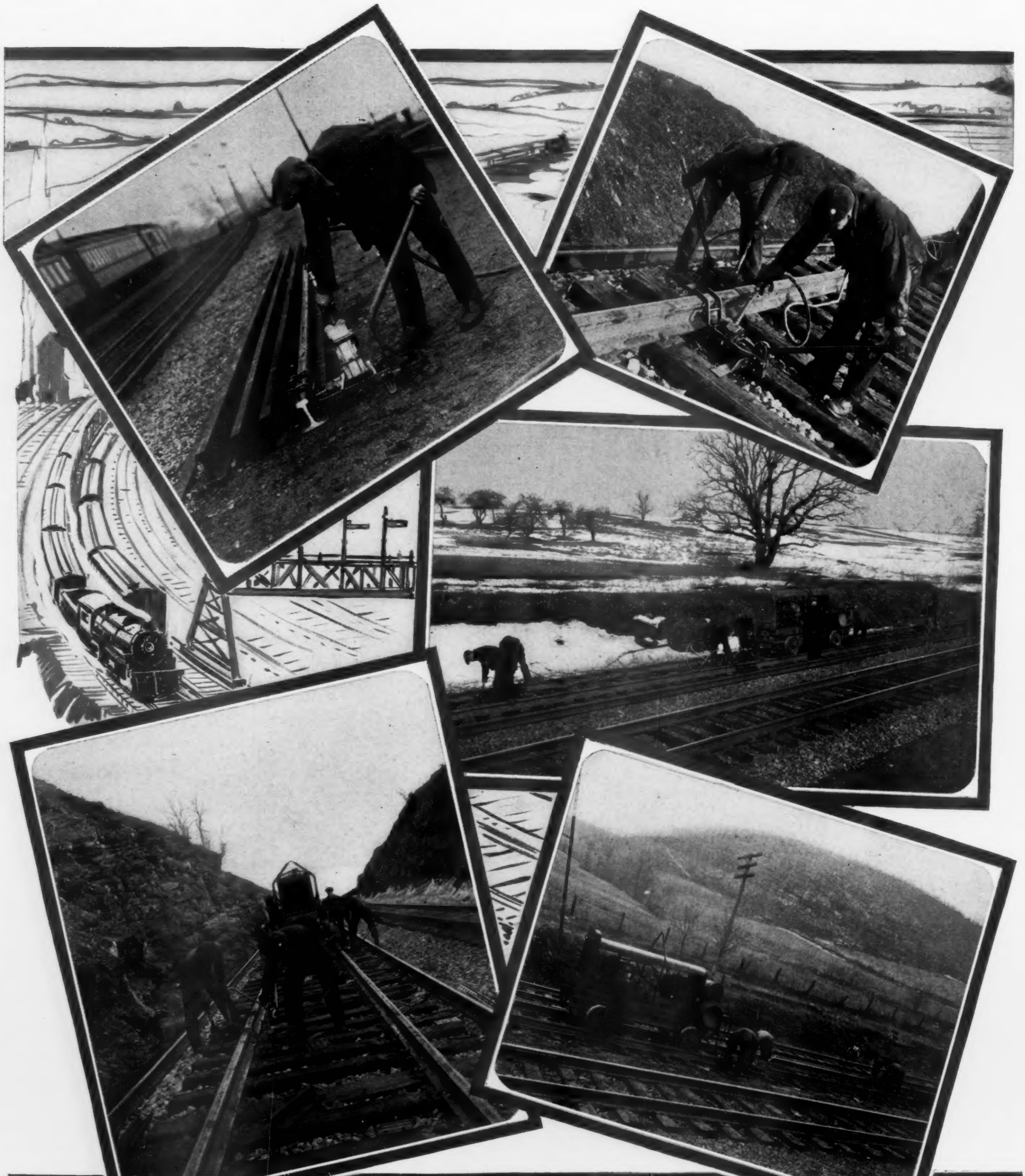
According to an esteemed contemporary, the *Railway Review*: "Rail laying at this season furnishes an employment for the winter forces which permits this work to be done at no additional outlay for wages, and with small loss of time in transporting the men so engaged. If computed on the actual cost of winter as compared with summer work of this character the figures will, of course, be higher for the winter work. But when it is considered that the rail is laid by forces which must be maintained, but which cannot, at all times, be efficiently employed on other work, and that the summer forces can go ahead with the season's work without interruption, the conclusion must be that the benefits far outweigh any disadvantage there may be.

"Records kept over a number of years indicate that, under this system, the cost per ton to lay rail is less than $6. This includes the cost of unloading the rail and fixtures, laying, applying the fixtures, and stripping and loading the old rail and fixtures. The main point to keep in mind, so far as cost is concerned, is that, to all intents and purposes, the rail is laid at no cost to the railroad other than the work train service."

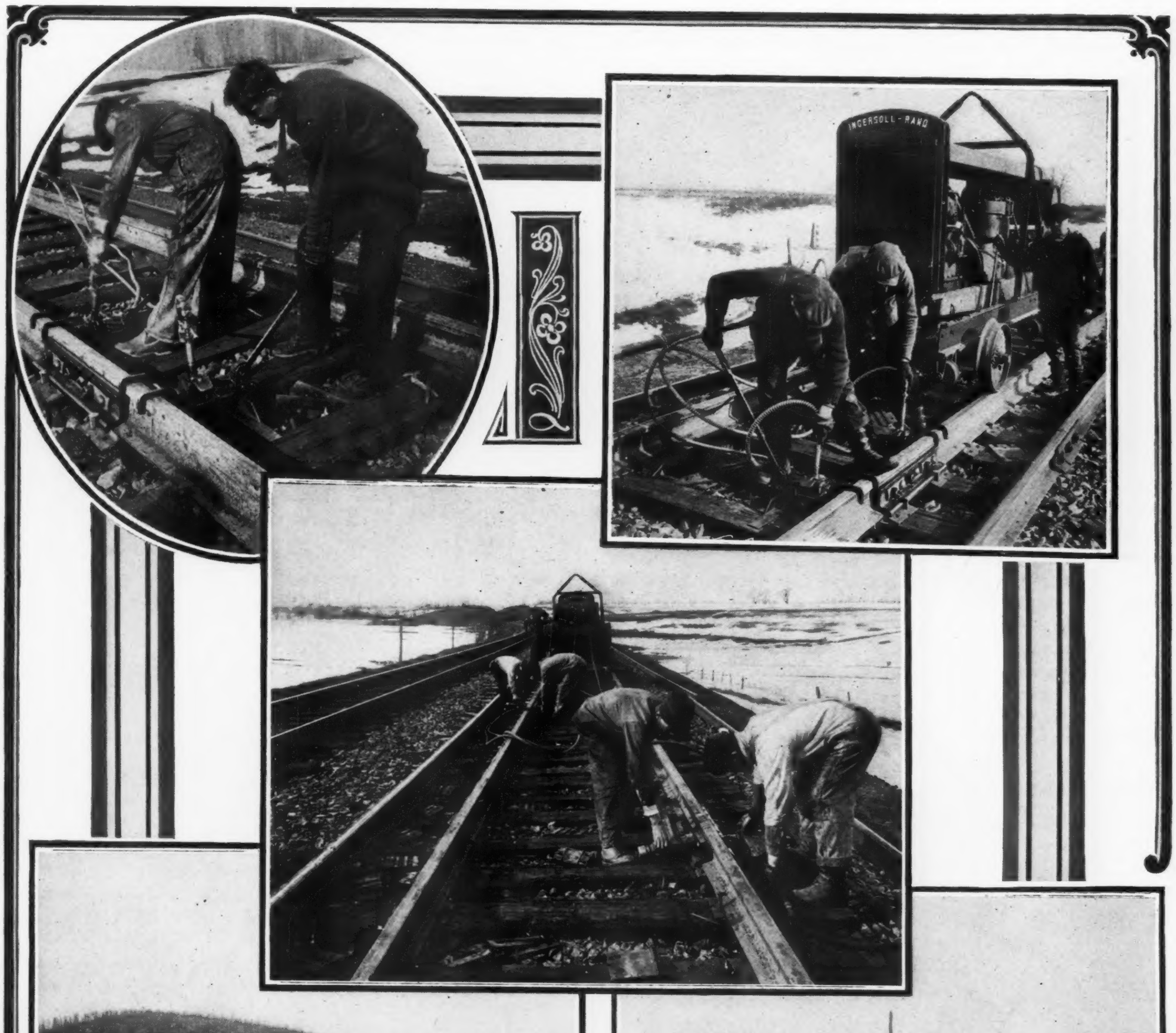
As evidence that the portable air compressor for year-round service will pay 100 per cent. interest on the investment involved, we point to the following uses to which compressed air furnished by it can be put: in operating riveting hammers, drills, reamers, wrenches, spike drivers, wood borers, tie tampers, rock drills, etc. Furthermore, the air can be used for sand blasting, spray painting, pumping water, charging train lines, for unloading frozen coal, cinders, etc., and for the chipping of ice around water pans.

The example set by the Lehigh Valley Railroad is being followed by the alert managements of other railway systems.

How the Lehigh Valley Railroad Makes Comparatively Using Self-Propelled Tie-Tamper Compressors



Light Work of the Laying of Rails in the Wintertime by Together with a Variety of Air-Driven Tools



Making a Victor Talking-Machine Record

By JAMES H. COLLINS

"TAKE the ferry a block up the street," said the Philadelphia waterfront cop, "and you can't miss it—the Victor works are right at the ferry in Camden." He might have gone further than that and said that the Victor plant was pretty much all that part of Camden, for it spreads all around the ferry landing—acres of big buildings where are made the Victrolas and the millions of black disks by which are reproduced the voices of great singers and the playing of great instrumentalists and orchestras.

Inspection department where the records are examined and passed or scrapped by sharp-eyed girls that are able to detect almost microscopic flaws.

It is hard to realize that a little more than twenty years ago the talking machine was a joke, and that this concern was housed in a little shop, seventeen feet square, where two young fellows counted themselves lucky if they took in $10 a week. One of them was a chap named Eldredge Reeves Johnson, a mechanical genius who believed in the phonograph. After a job-hunting trip to Seattle he had come back to Philadelphia with 50 cents in his pocket—his tools being held for freight. A friend redeemed the tools; and, together, they started a little shop in Camden because rent was too high in Philadelphia. A few years later, the Victor Talking Machine Company was paying Caruso royalties of $70,000 a year! It is said that if all the Victrolas and records now shipped by that concern in a year were loaded on one train it would reach from Camden to Albany, N. Y. And by the time of Caruso's death, in 1921, the company was paying him royalties of nearly $300,000 per annum.

"A wonderful thing!" said a philosopher after visiting the huge building where Victor records are made, "to be able to send some chocolate-colored dust into a factory and to have it become *Cèleste Aida*, sung by Caruso." We, too, have come to Camden to see this wonderful thing. Like a good many other folk who may have given the subject little thought, you may believe that Victor records are made of hard rubber, for they do resemble that substance. Actually, they are made of dust which is kneaded into dough, rolled out into "pie crust," and molded under 100 tons or more of hydraulic pressure.

That isn't the real start, of course, because the recording artist must first of all sing or the orchestra play to make the master record. The recording laboratory is a fascinating part of the Victor plant, and through it pass every year hundreds of famous singers, instrumentalists, orchestra conductors, bandmasters, choirs, and entertainers of every sort, creating music, etc., that will delight not only people in great cities but those in inaccessible places where no other form of entertainment ever comes. Fascinating, and also a secret mystery. Visitors are not admitted to this laboratory, nor to the branch recording laboratory in New York: they would distract the artists, for one thing. The making of master records is an occult business, with many technical refinements to be kept confidential. Even the artists do not see the apparatus: it is hidden in a separate room, and they sing or play into its silent, attentive ear.

Records are finished by grinding off any rough edges left by the presses.

To make a good record, the peformers must be placed with considerable skill. If a jazz orchestra is recording the *Hop Toad Blues*, for example, one instrument will be placed close to the recording apparatus and another some distance away from it to secure a good orchestral blend. More than that, one instrumental player may be seated on a high chair, another close to the floor.

The master record is made in a soft wax composition which may contain half a dozen separate ingredients in order to secure just the right consistency and "cut." In some cases, the composition is "insoluble soap"—the waxy ingredients having been turned into soap which will not dissolve in water. Generally, the microscopic grooves that record the music or entertainment are made by fine sapphire points. John McCormack sings a song or Paul White-

man's band plays a fox trot and a record, corresponding to the one that you put on your own Victrola, is cut into the soft composition. A popular number may sell 500,000 records. It is said that the fox trot *Whispering* sold nearly 1,200,000 Whiteman-Victor records, or more than 2,000,000 altogether—thus establishing a precedent.

How can so many reproductions be made from a delicate master record, when even to play it once would destroy it? It is done in this way: The master record is coated with graphite powder, like that used in a lead pencil, and is then put into an electrotyping bath and subjected to a gentle electric current. This current passes from a copper anode through the bath and to the graphite on the master record, which acts as a cathode. Invisible particles of the copper are carried to the graphite and deposited upon it until a thin metal film has been built up, reproducing the most microscopic details in the recording. This film or metal shell is removed; backed up with other metal; nickel-plated; and used as a die with which to press the kind of Victor records filed away in your cabinet.

The black dough from which Victor records are made.

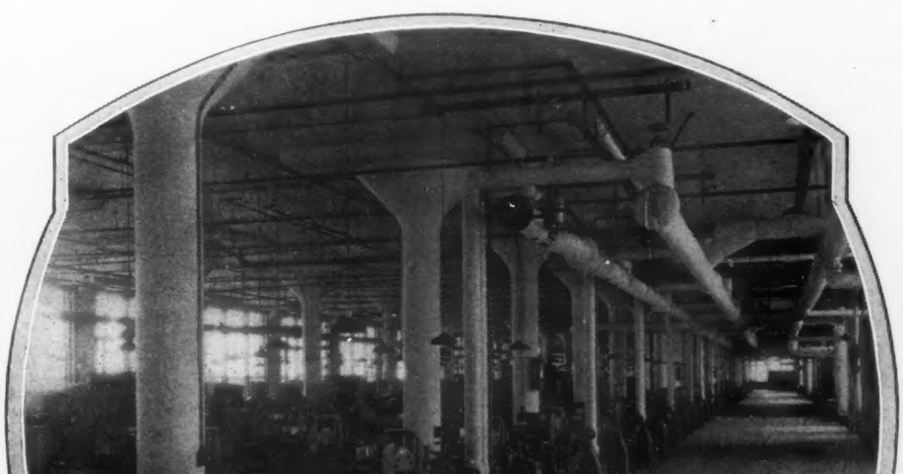
We will next look into the kneading of the dough from which records are made. This dough must be compounded and mixed for two different purposes: to work well in the factory while the record is being pressed and to play and wear well for the purchaser. More secrets! The ingredients for this dough are pretty well known, but the proportions in which they are mixed is a carefully guarded mystery.

One of the most important ingredients is powdered shellac. Coming from India in chips, shellac is the product of an insect which pierces the tender twigs of various East Indian trees, sucks their sap, and secretes a substance which dries as shellac. Some coloring material, such as carbon black, is required in the case of Victor records. Rotten stone, china clay, silica, and other things are added. One substance is put in for a filler, to give mass and wearing quality: another is added to reinforce the record, to make it strong. A good record ought to play between 75 and 100 times with a loud needle before showing wear. It must not be too brittle; and the composition must not be too smooth, for then the needle would slip through the groove so easily that tone would be lacking. Something like rotten stone is added to the formula to give friction and tone; but if too much of it were used the record would have a surface "hiss" in playing.

Another interesting ingredient put into the batch, in most cases, is "record scrap"—pieces of records that proved defective upon inspection and were broken up to be used again. Tons of records are thrown out after pressing and finishing because some tiny flaw, perhaps only a slight scratch or a single pinhole, is detected. All these ingredients are ground to a very fine powder and thoroughly mixed—everything being weighed carefully to maintain the right proportions.

This powder is a dark-gray mixture, a slaty black flour, that comes down from bins into the kneading machines. These machines have heavy metal rollers, akin to those on an enormous ironing machine, which are heated to 300°F. The powder goes into the rollers on one side and comes out a warm, black dough on the other—the heat having melted the shellac. Round and round the mass of dough is rolled and kneaded, about ten minutes to a batch. Then a metal table is wheeled up to the kneading machine and about 100 pounds of the dough taken away in a thick sheet folded over and over. While still warm, it goes into another machine that rolls it out into great long crusts, 4 or 5 feet wide and from 50 to 60 feet in length. This crust is scored in squares large enough to make 10- or 12-inch records. After being allowed to cool a minute or two it is run onto a long metal table, where men fold it over at the scored lines and break it up into the individual squares. Certainly, it doesn't look very brittle, as they slam it around, this disk "compo." Nevertheless, it is as fragile as hard-cooked gingerbread; and the men handle it quickly without breaking because they are adepts. These square rough "cookies" of shellac and rotten stone do not look much like highly polished phonograph records; but that is what the next operation will turn them into—songs by Alma Gluck, violin solos by Fritz Kreisler, Chopin nocturnes by Paderewski, band pieces, comic monologues, symphonies, quartettes, opera, whatever you please.

Prepare for a pleasant change. All the work has so far been done by men tending noisy machines in a sort of dark Inferno. Now we go upstairs into big sunny rooms, where hundreds of girls are pressing, finishing, and inspecting the sort of records you buy. There



The numerous presses that make the records as we know them.

are too many hydraulic record presses to count: row upon row of them, each with its quick, skilful operator. While we pause to watch one girl cook "mud pies" and turn them into fox trots, a dozen neighboring girls glance at us sideways. Why not? We are there to watch them—why shouldn't they glance and giggle at us? There must be hundreds of presses in that big room; but a visitor trying to count them would flee in confusion before he got up to twenty.

At her right, each presser has a sort of steam table, much like that used for making pancakes in restaurant windows, though smaller. On this table she places half a dozen of the compo cookies made downstairs. As the heat quickly softens them she folds the edges in, making a thick mud pie about four or five inches across. Before her is the record press, with its upper jaw raised and tilted back. The bottom jaw is flat, and holds one of the silvery metal dies made from a master record by the electrotype process described. In the upper jaw is another. These dies can be changed like forms in a printing press. The particular young woman we stopped to watch said that she had an order for a box of 10-inch, double-face records with a fox trot on one side and a waltz on the other. By a box she meant the wooden crate, in which records are carried round about the factory, holding about 85. When that order is finished she will get another to work on—maybe several days' run on a single popular number that is selling big at the moment. Many presses must work on the same record when its sales mount into the hundreds of thousands in a few weeks. It is said that the week after John McCormack sang for the radio, some of the music stores in large cities sold as many as 1,000 copies each of songs on his program.

In the center of each Victor record is a hole: in the center of the record press there is a pin that makes this hole. Over the bottom pin the attendant fits the label for the fox trot, upside down, and in the center of the upper die she fits the waltz label, also upside down. Then her mud pie is pressed over the center of the bottom die; the top die is brought down; and she turns on hydraulic power with a controller.

Of all forms of power, surely hydraulic is the softest spoken. A hundred and twenty-five tons—but it doesn't groan, yell, hiss, or even whisper. The jaws of the press just float together, and then open, and there is a polished Victor record, music on both sides, labels, and all. It will be ready to play in another minute or two, after cooling. Cold water circulates in the press back of the dies, radiator fashion, so that the hot compo is partly cooled in the pressing. This saves time and keeps the press going, for otherwise it would be necessary to let the disk cool before it could be lifted. By water cooling, it is possible to make records at the rate of one a minute, though that is too stiff a pace for anybody to keep up all day.

Around the edge of the record just made is a ribbon of surplus compo, squeezed out by the die. In this form, the disk is set aside to cool while another is being pressed. Then the first record is taken up again; the ribbon broken off and dumped into a scrap box; and the record slipped into a thick protecting envelope and put into a box, to be carried to the finishers.

More nimble-fingered girls. Each works at a machine with two felt-covered turntables, like that of a Victrola, which are a little smaller than the record and run up and down instead of flat. A record in the rough state is clamped between these two turntables; spun around by a motor; and the edge rounded off with an abrasive. After polishing, it is ready to go to inspectors—more girls. The pressers turn out maybe 40 records an hour, the finishers perhaps three times that many, and then the inspectors throw about one out of every ten into the scrap!

The inspectors sit at tables with plenty of steady north light pouring in at one side. Picking up a record, the light is allowed to play along its surface and around its grooves, but only for a few seconds. In that time, the inspector's quick eye either finds it perfect or detects tiny flaws that we would probably fail to see with a magnifying glass. Here is an imperceptible scratch across the groove, only an eighth of an inch long, but it would make a click if the record were played. Here is a small crack, and there a pinhole, and this record has a tiny hump of compo across a couple of its grooves. Blister, bubble, toil, and trouble—some shortcoming no bigger than a pinhead causes the discarding of an otherwise perfect and saleable record after all this work! Needless to say, the best brains in the Victor organization are constantly studying this expensive problem of "cripples," because each record has a retail value of from 75 cents to several dollars. When you make several hundred thousand of them daily, reducing the defective ones by even a fraction of 1 per cent. would run into real money.

This visual inspection takes only a few seconds and shows up every defect that would be revealed when playing a record, which would require several minutes. Nevertheless, a certain number of records are selected for the test of actual playing, so that when a record goes to the music dealer's shelves, for sale to the public, it is as near perfect as the Victor organization can make it.

Some idea of how this business has grown can be given in a few figures of weight and number. "You must make millions of them every day," I suggested to my guide. "Well, not that many," he said, "but we do make hundreds of thousands—and millions weekly." A 10-inch record weighs 7 ounces, and a 12-inch disk 10 ounces. Assuming that this factory turns out 300,000 records daily—one-third of them of the larger size—it makes every day something like 75 tons of finished records and probably handles 10 or 20 tons more of record scrap.

Now for numbers. Some interesting figures have been compiled by the *Talking Machine Journal*. As late as 1907, only about 7,000,000 phonograph records were made in this country; but by 1920 the output had risen to exactly one record per capita, or 110,000 000 yearly. Today it is around 175,000,000. Figure for yourself the number of tons of culture and relaxation that the American people annually carry home under the arm in packages of half a dozen or so records.

Thomas A. Edison once said that, to him, the record was the real marvel and mystery of the phonograph. A comparatively crude talking machine will recapture what is on a record. Modern cabinet machines have been, of course, carried to a high state of refinement in reproduction; but the essentials of the phonograph, itself, are just a turntable, a needle, a soundbox, and a loud speaker made of a tin funnel if you can't get anything else. But how all the complicated harmonies and melodies and rhythms of a symphony orchestra are recorded in the microscopic grooves, and how the human ear distinguishes them when those grooves are scratched with a steel needle or sapphire point—those are the things that stumped Edison.

A great deal of power of diversified kinds is needed in the big Victor plant—steam, electricity, hydraulic power, and even weight motors like those used in lighthouses for recording machines placed at distant points where electricity is not available. Among these forms of power, compressed air is employed in large quantities for many purposes. It does not enter anywhere into the actual making of records but finds many applications in the machine shops where talking-machine motors and parts are made, and in the big furniture plants where cabinets are built, as well as in the Victor power plant. Cleaning, chipping, sand blasting, and other familiar uses are found for air in the machine shop; and many of the mechanical devices used throughout the works are equipped with pneumatic clutches.

HELIGOLAND DISMANTLED

THE German island of Heligoland, in the North Sea, which was of great strategic importance during the World War, has been entirely transformed—its present status being that of a fishing station and a pleasure resort. It is believed that nothing like the work of demolition involved in dismantling this former great fortress and submarine base has ever been accomplished before. The harbor works and fortifications, constructed by Germany over a period of 24 years, cost approximately $175,000,000.

The methods of destruction employed included drilling and blasting, as well as cutting metal by flame. Nearly 200,000 cubic yards of masonry was razed; 60,000 feet of drilling was done; and 300,000 pounds of explosives was used. The outer entrance to the harbor has been completely blocked: it is now quite unprotected and will be useless for any but light fishing craft.

Half a century ago there was consumed in the United States a total of 500,000 tons of paper as compared with the present annual demand of 7,500,000 tons. It is predicted that 50 years hence, at the present rate of consumption, 20,000,000 tons will be required each twelvemonth.

Labor-Saving Equipment in Gas-Distribution Field Work

By J. E. BURKE*

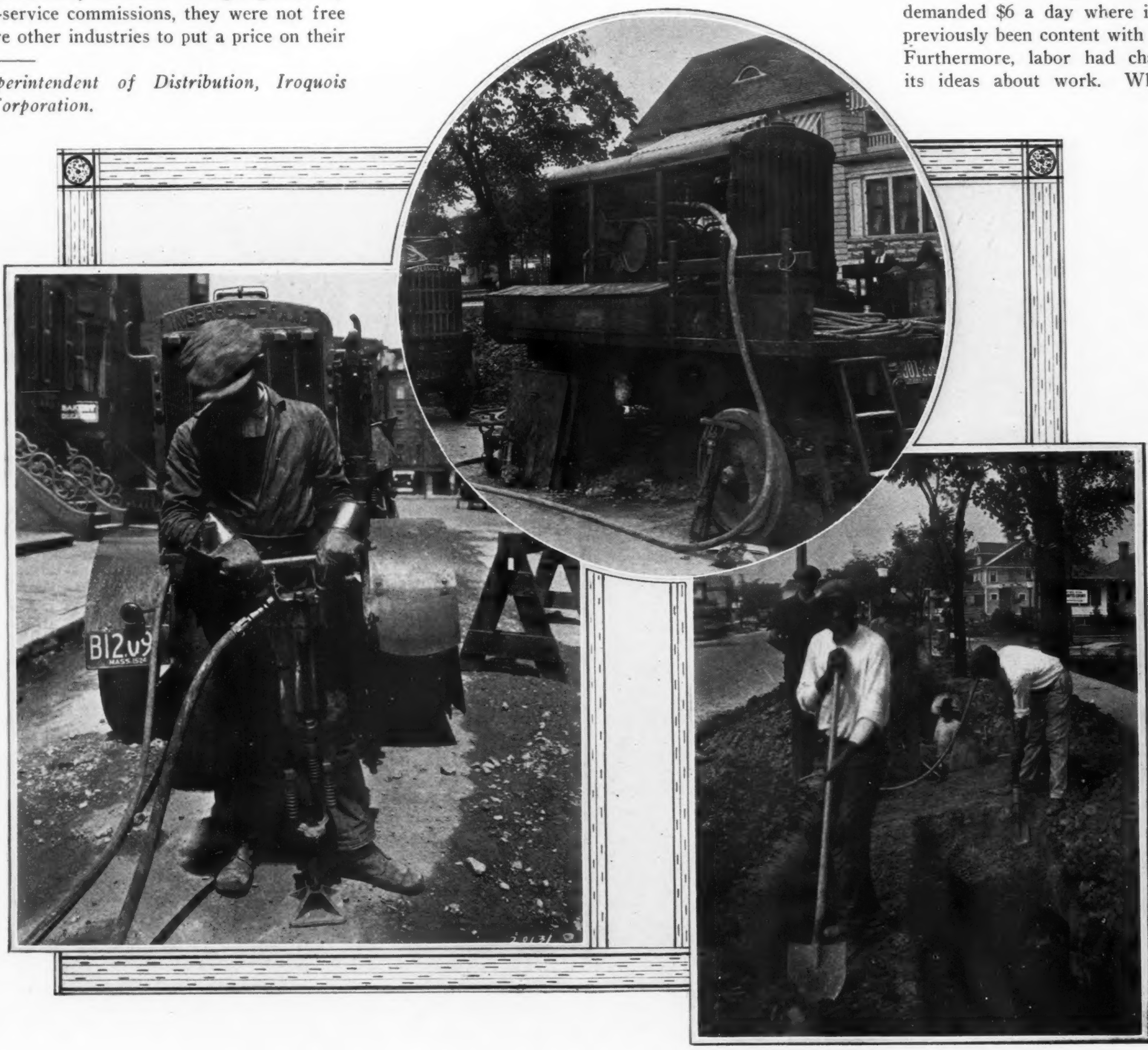
PRIOR to 1914 the gas industry, as a whole, devoted its energies to improving the methods of gas making. The distribution department had little to concern itself with except the regular routine work. The market afforded an abundance of materials at low cost with plenty of efficient labor.

With the advent of the World War we found ourselves in a new era. Nations were bidding against one another in our markets for materials—many of them paying premiums for quick delivery; and this led our manufacturers to seek the most profitable trade. Labor was quick to take advantage of the changed conditions. As a result, public-utility companies were particularly hard hit. Being regulated by public-service commissions, they were not free as were other industries to put a price on their products according to the cost of production. Public utilities had to face rising costs with no power to prevent monetary loss. In the gas field there were many serious problems to solve, though modern methods had already placed the production of gas upon an efficient and economical basis. Undoubtedly the worst of these problems was found in the distribution of the product.

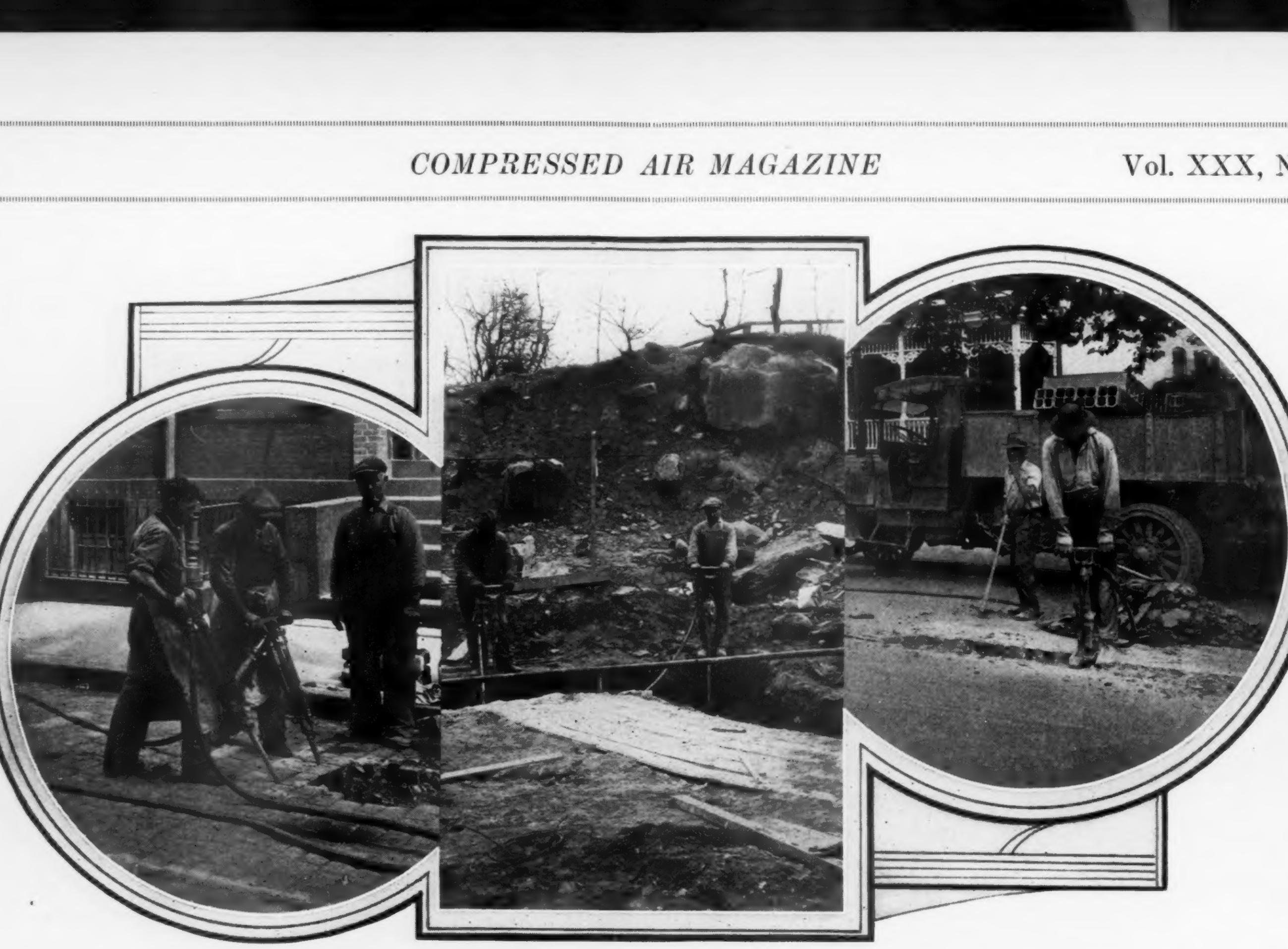
During the period of war, piping for mains could not be purchased on account of war necessities. Labor, attracted by fabulous wages, left our picks and shovels unmanned. In the face of prevailing conditions we had to resign ourselves to the situation; and we could do no more than muster a few men into emergency crews to take care of such emergencies as could not be left without attention. This meant that extension work was abandoned; mains were left without care long after they should have been repaired; and minor repairs only were attempted.

In the year following the termination of war, many companies—after long and costly litigation—secured better rates. This enabled them to finance the extensions and repairs that their distribution systems so badly needed. But the price of piping had just about doubled during the war, and labor—having become accustomed to higher wages and the greater luxuries higher wages afforded—demanded $6 a day where it had previously been content with $2.50. Furthermore, labor had changed its ideas about work. What it

Superintendent of Distribution, Iroquois Gas Corporation.



Left—Concrete breakers equipped with tamper pads can be used effectively for other work.
Circle—Portable compressor mounted on a motor truck and employed to supply motive air to tools used on pipe-laying jobs.
Right—Excavating for gas mains can often be made easier by utilizing air-driven trench diggers.



Air-driven paving breakers and "Jackhamers" make comparatively short work of excavating for gas mains either in town or in outlying districts.

then considered a day's work did not amount to one-half of the effort bought in pre-war days for $2.50. Consequently, it was necessary to offset the high cost of labor by doing mechanically what had been done manually. The gas industry determined to find machines with which a few men could replace many men and, with this determination, started what later became a crusade against inefficiency

Much, it is believed, has been accomplished towards this end; and it is the purpose of this article to state what has been done. The subject may be conveniently separated into three divisions: trenching and back filling machines; portable compressors and air-operated equipment; and motor trucks. Before devoting ourselves to the consideration of the individual divisions, it might not be out of place here to tell something of their interdependence.

The Iroquois Gas Corporation, of Buffalo, N. Y., first turned to trenching and backfilling machines as a solution of its problems. These machines proved very successful where there were no obstructions, such as trees, curbs, sidewalks, laterals, boulders, etc. Where obstructions were encountered it was necessary to put on a pick-and-shovel gang. This gang had to be large enough to keep close on the heels of the trenching machine and, being often idle, was expensive. We therefore adopted portable compressors and air-operated apparatus of various sorts to replace the follow-up gangs. Motor trucks, of course, were already being used: we simply added more trucks to our fleet. The experience of the Iroquois Gas Corporation is that these three classes of equipment, when used in conjunction with one another, are the only logical solution of the problem of gas-distribution field work.

As previously mentioned, labor has not adjusted itself to any reasonable degree to conditions prevailing since the World War and, as a consequence, the cost of laying mains remains a serious matter especially when considering only hand labor. This state of affairs, it must be admitted, is not local but general. Some three years ago our corporation realized the impossibility of continuing work with hand labor; and, as the cost of excavating prior to laying mains was the greatest item of expense, we undertook a considerable amount of ex-

Left—Testing for gas leaks by means of holes quickly driven through frozen ground with a "Jackhamer."
Right—An Ingersoll-Rand paving breaker driving sheet piling in soft ground calling for the construction of a cofferdam.

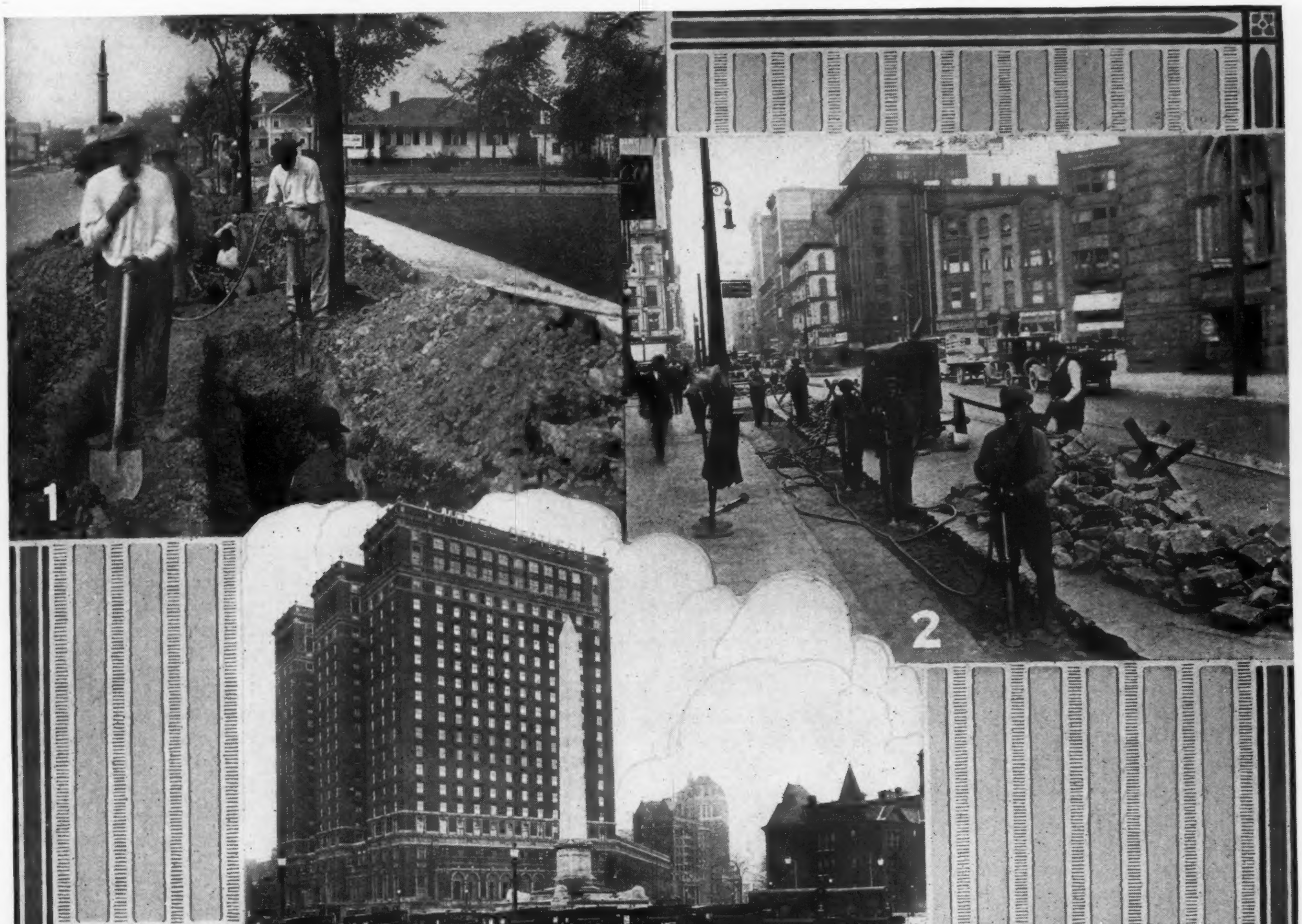


Fig. 1—Air-driven trench digger loosening clay in an excavation for gas mains.
Fig. 2—Tamping dirt in a trench with air-operated back-fill rammers.
Fig. 3—Line-up of Ingersoll-Rand portable air compressor outfits in the service of the Iroquois Gas Corporation, Buffalo, N. Y.
Fig. 4—Calking gas-main joints with Ingersoll-Rand calking hammers.
Fig. 5—Excavating bell holes in trench with 56-H clay diggers.

Here we have a No. 3 "Leyner" sharpener busy turning out bits for "Jackhamers" and paving breakers used in gas-distribution field work.

perimenting with the thought of eliminating as far as possible this undesirable factor.

We made arrangements with a local trenching-machine agent to place a machine on our work so that we could ascertain whether machine work would be practical and, at the same time, cut costs. We wanted to determine certain facts, and among these were: first, to what extent could a trencher be used in cramped places? While the machine, such as we used in our experiments, cut our costs to a great extent, we found that we were compelled to move the machine around too many obstacles, thus losing each time anywhere from six to fifteen feet of machine digging which had to be dug by hand. This, of course, offset to some degree the saving effected by the machine.

Another question we asked ourselves was: what damage would a trencher do to concrete sidewalks by reason of operating on them? We found that the machine we were experimenting with was entirely too heavy for use on sidewalks, even though we laid heavy 3-inch planks between the sidewalk and the caterpillars of the machine. Broken concrete walks are an expense, as our corporation is compelled to replace all damaged walks with new concrete. Deducting this cost reduces the savings made possible by machine work.

Another question we then asked was: how economically could a machine be used on short jobs on which the machine would have to be moved often either under its own power or by trailer and for distances varying from ¼ of a mile to 4 miles? This question is perhaps the most important and most serious of all, as it involves great expense especially where a machine is weighty and unwieldy. However, hauling from job to job is not the only serious item of expense when a machine is used on minor work, for with a machine of great weight and dimensions considerable time and labor are required to place it in position to begin actual excavating and to remove it from the work.

The machine that we used in our experiments was of the ladder type and weighed eight tons; and, on account of its weight and over-all dimensions, was unsuitable as a part of our equipment. Notwithstanding its weight and dimensions—which did not react any too favorably—our success in determining the practical features of the machine can best be explained by saying that with its help we laid thirteen miles of pipe that season. Using hand labor we could not have completed more than three miles of main.

These experiments formed the nucleus for our present equipment of trenching machines consisting of three Parsons Model 18, weighing six tons each, and one Parsons Model 20 backfiller. After two seasons' use of these machines we reached the following conclusions: first, that machine work is not only practical but preferable and economical; second, that what is required is a small trencher, preferably of the wheel-digger type. The ladder type was the only one previously available; but since we purchased our machines there has come into the market a small, wheel-type trencher, known as the Cleveland, built in Cleveland, Ohio, by a contractor who has had perhaps 30 years' experience in the laying of pipe lines and conduits and in the use of all kinds of trenching machines. We first witnessed this trencher in operation on work in Cleveland of the East Ohio Gas Company. There was a noticeable lightness in its construction: yet careful examination showed plainly that it was a sturdy, practical machine with comparatively fewer working parts to get out of order.

We made arrangements to have one of these machines placed on our work last June; and we used it for the balance of the season, comparing it with the older machine. We find that it will dig within seventeen inches of obstructions, which is closer than our earlier machines could come. It can be placed into digging position more quickly; can be turned in its own length; and, owing to its light weight, can be used on lawns to dig trenches for laterals. It can be moved by its own power onto a trailer and towed to another job with little loss of time. During four months of actual digging, the sharpening of the digging teeth was the only attention this machine required: no parts needed replacement.

This small Ingersoll-Rand compressor provides the air needed in the blacksmith shop of a public-service gas company.

Mechanical methods are now preferred in tearing up and in replacing paving so that traffic will be interrupted as little as possible in busy thoroughfares.

Further proof that machine work is more efficient and economical than hand labor is that within one-half hour after a trencher begins operation on a new job every individual there is doing useful work. Contrast this with hand labor, where pipe layers and calkers have to wait hours for enough trench to begin actual pipe laying. Another important feature in connection with machine work is the fact that most of the earth excavated can be placed back as cover, because the machine breaks it into such small particles that replacement is easy.

Just prior to the war an American manufacturer developed a portable air compressor. The Italian government used a great number of these machines to operate "Jackhamer" rock drills for building roadways over which men and munitions were moved to the defense of the frontier. A few of these units appeared on highway improvements in this country. Following the armistice, their great possibilities were more completely determined; and other tools, such as the paving breaker, the clay digger, the back-fill tamper, etc., were developed or adapted to broaden the field of usefulness of the portable compressor.

The Iroquois Gas Corporation has ten of these portable outfits—eight 5x5-inch size and two 8x8-inch size—in everyday use at Buffalo. Some have been mounted on standard 1-ton Ford trucks on which are built large tool boxes to accommodate the two "Jackhamer" drills, the two paving breakers, the three clay diggers, the three back-fill tampers, and the three calking hammers with which each outfit is equipped. In addition to this there is provided a hose rack on top of each outfit so that we can conveniently carry six 50-foot lengths of ½-inch and six 50-foot lengths of ¾-inch air hose. Those of the larger type are on trailers and equipped in much the same manner as the smaller machines.

When these outfits are sent out, $1.50 an hour is charged to each job. This charge takes care of the entire expense involved in the operation and the maintenance of an outfit with the exception of the tool operator's wages. It includes the pay of the truck driver—who also operates the compressor, gasoline and oil for both the compressor and the truck, and repairs, up-keep, depreciation, and obsolescence of compressor, truck, tools, etc.

Had it not proved profitable through both time and money saving, we should never have gone in for the use of air-operated equipment to the extent we have. In fact, our use of such equipment would never have gone beyond the experimental stage. There is no question about the savings. Large savings are being made, as shown in the following tables of comparative costs for rock drilling:

BY HAND

Using ball drill

Labor, 9-hour day, at 45 cents an hour	$4.05
Total daily cost	4.05
Feet of hole drilled	8
Cost per foot	0.58

BY MACHINE

Using "Jackhamer"

Labor, 9-hour day, at 45 cents an hour	$4.05
Overhead, at $1.50 an hour	13.50
Total daily cost	17.55
Feet of hole drilled	84
Cost per foot	0.208
Saving per foot	0.372
Saving per foot, per cent	64

In addition to this 64 per cent. saving, it is well worth while to consider the time element. Ten and one-half days would be required to drill 84 feet of hole by hand whereas but one day would be needed to drill that amount by machine, and the cost would be $42.52 as against $17.55. The time element may, of course, be got around by employing more men; but when twelve or thirteen men are used instead of one there is an increase of more than 1,000 per cent. in the cost of workman's compensation insurance.

In breaking pavement consisting of 1½-inch asphalt top, 1½-inch binder, and 6-inch concrete base, the comparative costs are as follows:

BY HAND

Using wedges, sledge hammers, bars and picks.

Three laborers, 9-hour day, at 45 cents an hour	$12.15
Total daily cost	12.15
Square feet of concrete broken	81
Cost per square foot	0.15

BY MACHINE

Using paving breakers.

Two laborers, 9-hour day, at 45 cents an hour	$ 8.10
Overhead, at $1.50 an hour	13.50
Total daily cost	21.60
Square feet of concrete broken	560

Portable compressors and air-driven tools make it possible for men to work a great deal faster than pick-and-shovel gangs.

Cost per square foot 0.0386
Saving per square foot 0.1114
Saving per square foot, per cent........ 74

Here, also, the time element should be considered, as the two laborers using machines can do as much work in a day as 21 laborers could do in the same length of time by hand methods.

The air-operated tamper strikes hundreds of hard blows a minute, rams the fill hard, and works in and around the pipe with far greater thoroughness than hand tampers. Where pavement must be re-laid over a trench, these things are absolutely essential, for unless the packing is thoroughly done the ground will settle and cause depressions in the pavement. There are two good reasons for guarding against settling. In the first place it is expensive to re-lay pavement, and in the second place the depressions may cause accidents or loss of life. Of course, every case of hand-tamped back fill does not result seriously; but in every case three men with air tampers can replace fourteen men with hand tampers—with a resultant saving in cost of approximately 58 per cent. Considerable stretches of our mains are laid under parkways, that is, the space between the sidewalk and the curb. In using trenching machines we have found that in all but exceptional cases the earth is so finely granulated that "water settling" can be employed in these parkways to advantage. In the exceptional cases, however, air tamping is resorted to.

In addition to supplying compressed air for operating its usual complement of tools, we have found the portable compressor suitable for various other purposes. In laying new sections of main we test for tightness with compressed air. At our new gas plant we used portables with riveting hammers to rivet tanks and other plate and structural work. We have high-pressure mains under the Niagara River. Just recently it was necessary to locate an old abandoned main under the river. One end of the pipe had been disconnected years ago and its location forgotten. Air was forced into this pipe from a considerable distance inshore, and the lost end located at once by the air bubbles. The portable may also be used to supply air for cleaning and painting, for operating cement guns, and for numerous other odd jobs.

The principal application of the "Jackhamer" is, of course, that of drilling rock. It is indispensable where boulders are frequently encountered; and it may be used for breaking through concrete and frozen ground in testing for gas leaks.

The services to which the paving breaker may be put are probably more varied than its manufacturer ever expected them to be. Fitted with a moil point, it makes quick work of breaking out concrete, frozen ground, or hard subsoil, of loosening paving blocks, and of cutting holes through reinforced concrete walls. Fitted with a chisel blade, it may be used for cutting asphalt. Another type of blade makes it a powerful digger for hard clay and for ice.

In addition to its primary use for calking pipe, the calking hammer may also be utilized for calking tanks and cleaning paving brick. When applied to the latter purpose, 150 to 180 bricks may be cleaned in an hour, whereas no more than 65 could be handled by hand in the same interval. In the case of the back-fill tamper, we know of no use other than tamping back-fill to which this tool has been put in our particular industry.

Where we have had to have a trench just a few inches wider than the trenching machine could cut it we have very satisfactorily solved the problem by placing a man with a clay digger on either side of the machine and having them slice down the sides of the trench. We have not as yet found a trenching machine that will round corners successfully; and, for the time being at least, the clay digger continues to be the most economical tool for the purpose. Tunneling under sidewalks and other obstructions, however, is the work to which the clay digger is best suited.

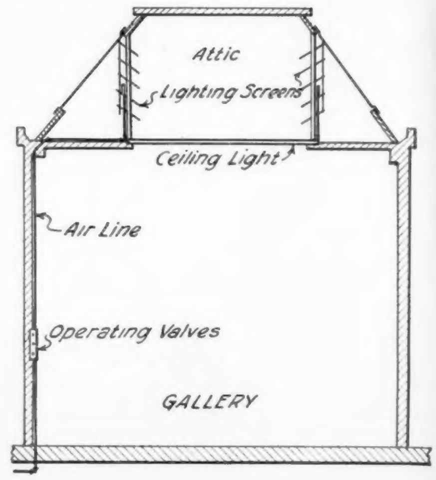
To facilitate the handling of drill steels in our blacksmith shop, and to assure a plentiful supply of sharp drills with good shanks, we have installed a sharpener. This is also a pneumatic machine which draws its needful operating air from a compressor of the stationary, horizontal type.

Paper read before the Empire State Gas & Electric Association at its meeting in Utica, N. Y.

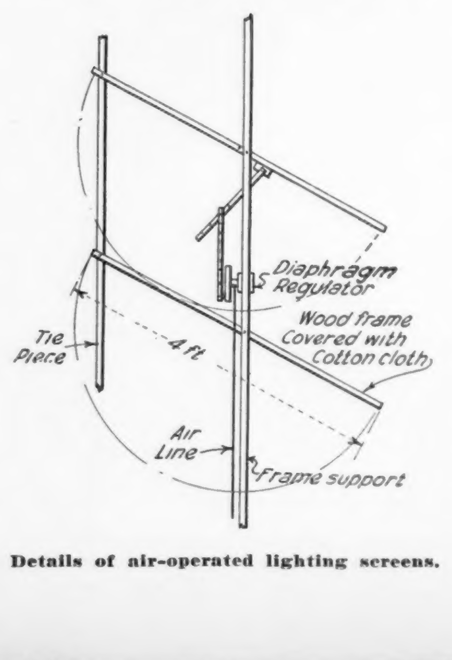
AIR-OPERATED SCREENS TEMPER LIGHT IN MUSEUMS

IN most museums of art it is the practice to use screens, technically called *louvres,* for the purpose of tempering the natural light so that the statuary, pictures, etc., will appear to the best advantage at all hours of the day. In the Museum of Fine Arts in Boston these screens are manipulated by means of compressed air.

The screens, themselves, consist of unbleached cotton cloth stretched on frames about four feet wide and eight feet long, and are pivoted in stationary wooden supports, as shown in the accompanying diagram. An operating unit is composed of a number of screens, arranged vertically in a single panel, which are shifted in unison. All the screens are moved by diaphragm regulators worked by compressed air at a pressure of fifteen pounds per square inch. These regulators are controlled from a central point in the building.



General arrangement of pneumatically controlled lighting screens.



Details of air-operated lighting screens.

The control board—located on the main floor of the gallery—looks not unlike an electric switchboard, and is made up of a number of valves each of which is connected to a diaphragm regulator that operates a single set of screens. The angle at which a group of screens is set depends entirely on the way in which the associate diaphragm regulator is set—that is, when a greater range of opening, for example, is desired, the regulator arm of the diaphragm must be adjusted accordingly. These adjustments are made to suit light conditions at different seasons of the year.

Air for the system is furnished by a small compressor having a capacity of six cubic feet of free air per minute. This machine delivers the air to receivers conveniently located in different parts of the museum. The action of the compressor is automatically controlled so as to provide an approximately uniform pressure of from fifteen to sixteen pounds in the air line. It is interesting to note that the Boston Museum, before deciding on the lighting system described, conducted numerous experiments and made a thorough investigation of the methods employed in other galleries.

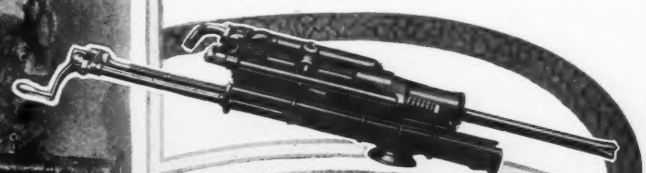
At the 133rd regular meeting of the American Physical Society, held this year in Washington, D. C., Mr. P. W. Bridgman, of Harvard, reporting on the viscosity of organic liquids at high pressures, said that "all the liquids tested became more viscous at high pressures and moved more sluggishly." This is attributed to the interlocking of the molecules, which causes the liquid to take on properties more nearly approaching those of a solid. The increase in viscosity was found to vary enormously with different liquids—being only 10 times in the case of methyl alcohol and 1,000,000 times for eugenol. The pressure ranged all the way from 15 to 170,000 pounds per square inch.

Suggestions on the Care and Use of Rock Drills

By E. R. BORCHERDT AND H. D. SULTZER*

PART II

WEAK rotation and loss in drilling speed from other causes than lack of oil may be due to loose or unevenly tightened side rods, permitting loss of air through the front head. The side rods should be drawn up snug, but not tight enough to compress the springs. If the piston strikes the heads when the springs are compressed there is danger of breaking the side rods, and if the machine has lost its cushion from defective valves or a worn cylinder washer the front head will, sooner or later, be broken. A machine which continually strikes the heads, even when cranked up against the ground, should be sent to the shop for repair.



A "Leyner-Ingersoll" R-72 drifter, mounted on a shaft bar, at work in a well-known copper mine.

Here we have another R-72 drifter set up on a column and performing with equal effectiveness.

In drilling in soft ground or vug holes, or when reaming a hole, it is necessary to hold back on the crank, at which times running with a half-open throttle is most satisfactory. The maximum drilling speed is obtained when the machine is cranked to the ring of the steel. Crowding the crank shortens the piston stroke, weakens the rotation, and grinds off the cutting edges of the bit.

A bent feed screw makes a lot of extra effort necessary in cranking and is usually caused by dropping the machine and allowing it to strike on the end of the front head. It is sometimes damaged by slapping around in the shell when the feed-screw support nut has been removed in order to gain several inches in the feed.

Keep the oil plugs tight. If the front head or cylinder plugs are lost the drilling speed is slowed up and the machine will not retain oil.

If the nuts on the lubricator or valve bolts become loose be careful not to draw them up too tight, as the end of the bolt is readily twisted off with a large wrench.

Rubbers especially made for the water spuds are furnished. Should they be slightly too long they will close the holes in the brass screen when the water-connection nut is tightened. If this occurs, remove the rubber and cut off an eighth or a sixteenth of an inch and replace it. The use of red-rubber gaskets in the water spud is to be discouraged because they are readily cut by the water-connection nut, and frequent pluggage of screen and tube results.

Proper alignment of the drifter machine and steel is of utmost importance. Running a machine out of line slows up the drilling speed and increases the chance of sticking the steel, besides putting additional strain on the rotation and contributing to piston breakage. A miner who spends a few extra minutes on each hole in keeping his machine in line will drill many more holes in a shift than one who fights the hole through without regard to line.

Do not make it a practice to drill with a loose swing clamp. It might be justified to finish a tight hole, but as a general practice it will result in lost time.

If too much water is used in drilling "down holes," the coarse cuttings will stay in the bottom of the hole and pack around the bit, while the finer material runs off with the water. This is the cause of many cases of stuck steel, especially when square steel is used; and it will be found helpful if less water is used so that the cuttings will form a thin mud, which can be more readily removed by the machine. Closing the water valve for an instant while holding back on the crank will help "mud" the hole by permitting a larger amount of air to get to the bottom of the hole and to blow out the cuttings. In soft down holes, be sure to hold the steel off the bottom of the hole until the water has a chance to get to the end of the steel.

The water tube for a round steel drifter is two inches shorter than the one used in the square chuck machine. Occasionally, the wrong-length tube gets into a machine and causes trouble. If the short tube is used with square steel it does not project into the steel, and most of the water, instead of getting to the bottom of the hole, leaks out of the chuck. If a long needle is put into a machine requiring a short one the tube will project too far into the steel and is likely to be damaged.

Efficiency engineers, Anaconda Copper Mining Company

Every effort is being made to have the steel going into the mine as near perfect as possible; but occasionally a hard or soft shank will slip by undetected and cause trouble, which might have been avoided had the miner inspected the shank end when he selected his steel at the station. It is not worth while taking a chance by using a shank that is upset on the end and does not enter the chuck freely, for, after using, it may be impossible to remove it. The machine must then be sent on top. If shanks are being upset in the machine the trouble may be caused by a cupped or chipped anvil block. If upsetting occurs around the water hole a sharp bur is formed, which may cut off the water tube. This does not apply to stopers, in which type of machine an anvil block is placed between the steel and the piston and the water tube does not project above it. A chipped shank usually indicates that it is extremely hard and very likely to chip further and cause damage to the machine. Sparks from the chuck of an anvil-block machine indicate that there are steel chips between the steel and the anvil block. The machine should be immediately stopped before damage to the water tube or anvil block results. Never put the end of a broken piece of steel in a machine.

In extremely abrasive ground, such as is encountered in parts of the Anaconda mine, rapid wear of the gage of the steel is a serious problem, and a large per cent. of time is spent in making steel changes. The maximum distance that one steel can be run, regardless of other factors, is determined by the length of the feed of the machine. This varies from 18 inches in the stopers to 24 and 30 inches in the drifters. However, the maximum practicable distance a steel may be run is governed by the gage loss which will permit the next steel to follow. This point is sometimes indicated by the bit beginning to bind in the hole; but frequently, when the binding point is reached, the gage will have been worn so much that the next steel will not follow to the bottom of the hole and reaming is necessitated. The so-called reaming results in only slight enlargement of the hole; but it wears off the gage of the new bit so excessively that its useful drilling life is very much shortened before the bit reaches the bottom of the hole, and the gage will be completely gone before the hole is deep enough to receive the following change. Had the first steel been used only for the distance necessary to make the change the bottom of the hole would have been of sufficient diameter to accommodate the following gage change without reaming, and the hole could have been advanced with less expenditure of time and energy.

In this case the wet drill is a No. 248 "Leyner-Ingersoll" drifter in action in a Butte mine.

In the most abrasive ground of the Anaconda mine it has been found that a bit will retain its gage enough to permit following without binding when a 12-inch run is used. In order that this shorter change be used to best advantage, it is imperative that not more than twelve inches be drilled with each steel except the finisher, which may be run until it sticks. With the six changes, which will be the standard used at this mine, a hole of something over six feet can be drilled in the hardest ground, even where white-quartz vug holes are encountered. Where hard ribs are only occasionally encountered, and in which an 18-inch change cannot be made without resorting to reaming, the use of two sets of steel—changed alternately every inch or so—will make it possible to bottom the hole. This was strikingly shown in a recent test in the hardest drilling ground in the camp, where the first hole was put in by using the steel until it stuck before the change was made. The next change would not reach the bottom of the hole due to excessive gage loss of the first steel. This necessitated enlarging the bottom of the hole or wearing down the gage of the new bit enough to permit it to reach the bottom, or it called for the use of a combination of both. This so-called reaming operation consumed a lot of time and energy in pounding and twisting the steel, as is shown by the total drilling time of 50 minutes required to finsh a 5-foot hole.

The next hole was drilled in the same character of ground, but instead of using one steel for a full run the gage loss was distributed between two sets of steel of equal length and gage. The hole was collared to a depth of two inches with starter No. 1. Then starter No. 2 was run for a distance of two inches and changed back to starter No. 1 previously used in collaring the hole. Alternately changing these two pieces of steel every two inches was continued until the hole was deep enough to take the next change. The alternate changing of steel every two inches was continued until the hole was finished. This distributes the gage loss between the two sets of steel so that one follows the other without binding. The number of times the steel was changed was of course greater, but the total time required to drill this 5-foot hole was only 30 minutes as compared to 50 minutes for the preceding hole.

When it is necessary to pound the steel, as it certainly is at times, be sure that you do not damage the machine by striking the front head or cylinder. A great deal of unnecessary pounding can be eliminated if proper care is given the machine and the steel is changed as soon as the gage is gone.

Miners have, at times, received machines from the shop which have not been in first-class operating condition, and this has given rise to the belief that machines sent to the shop for repair frequently receive little more attention than a dose of oil. This, however, is not the case, as each machine as it comes to the shop is taken apart to determine the reason for its being sent up and is put in what is believed to be first-class order before it is returned to the mine. However, it is sometimes difficult to locate the trouble; and what may appear to be good running order in the shop may be unsatisfactory under actual drilling conditions. At present, a system of shop testing is being worked out which will more nearly duplicate actual mine conditions and assure a perfect running machine when it is set up underground. The miner can assist in eliminating this trouble if he will leave a note on the machine or tell the nipper why it is being sent to the shop, so that the repairman will have some idea of what to look for. To sum up:

Keep the side rods drawn up snug but not tight enough to make the springs solid.

Send the machine to the shop if it continually strikes the heads when the machine is cranked against the ground.

Do not run with wide open throttle when cranking the steel out of the hole, or when holding back on crank is necessary in soft ground.

Do not crowd the crank: this reduces the drilling speed.

Do not remove feed-screw support.

Keep the oil plugs tight.

Be careful not to twist off the lubricator or valve bolt when tightening the nuts.

Do not use red-rubber gaskets in the water spud.

Do not drill with the machine out of line.

Do not drill with a loose swing clamp.

Do not use too much water, particularly in down holes.

Do not take a chance by using a chipped or slightly upset shank.

Examine anvil block frequently to see if it is causing shank trouble.

Do not run your steel too far.

Call the nipper's attention to the trouble with the machine when it is sent up for repairs.

(To be continued)

Reprinted by courtesy of The Anode.

NEW QUARRY AND MINING SHOVEL

TO meet the growing demand for a quick-acting, full-revolving shovel of large dipper capacity, the Bucyrus Company has brought out a 4-yard machine known as the 120-B. This shovel is especially suited for work in confined spaces and narrow cuts, such as mines, quarries, etc., and where hard digging conditions are encountered.

According to the manufacturer, the shovel is of exceptionally sturdy construction—the base and the revolving frame being made of solid castings. These features are without structural work, rivets, and bolts. The boiler, which has a fire-brick arch, has a 10 per cent. larger grate area and a 15 per cent. greater heating surface than that of the most powerful railroad-type shovel. The boiler efficiency is still further increased through the installation of a superheater, which makes it possible to reduce the water and the coal consumption by from 20 to 30 per cent.

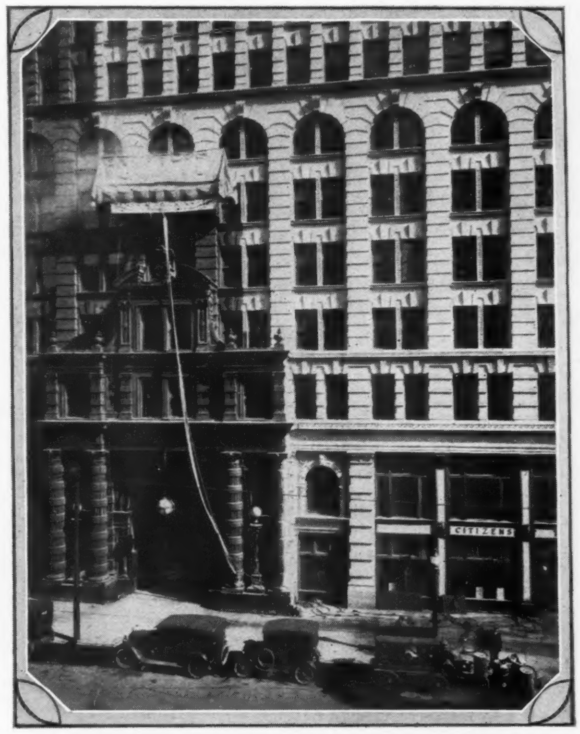
The shovel is the largest of its kind yet to be mounted on caterpillars; and it can be operated both by steam and by electricity. A bulletin descriptive of the 120-B model may be obtained gratis from the Bucyrus Company.

SAND BLASTING REVEALS HIDDEN ART

A SAND-BLASTING job of more than usual magnitude was recently concluded in Buffalo, N. Y., where the huge Ellicott Square office building has been cleaned in this fashion. This building occupies an entire square; and was one of the first steel-frame structures to be erected in that city. It was designed by Daniel Hudson Burnham, the well-known American architect who had done so much to make the Chicago World's Fair a success from an architectural point of view.

In the 30 years of its life, the walls of the Ellicott Square building had become so weather stained and begrimed as to destroy or conceal much of the ornamental detail of the facades; and it was therefore decided to clean the structure. The contract for the work was awarded to the Atlantic Terra Cotta Company, which put two portable sand-blasting units on the job.

More than 100,000 square feet of wall surface—consisting of granite, terra cotta, and a veneer or pearl-gray brick—had to be gone over in panels having a width of 25 feet. All told, 36 such panels were sand blasted. As the cleaning progressed, the decorations were revealed anew to an admiring public that had long been unaware of what the covering of accumulated dust and dirt concealed. Once more we have evidence of the transformations which can be wrought through the skilful use of the sand blast.



Sand blast used to clean and to bring out anew the decorative features of one of Buffalo's big business buildings.

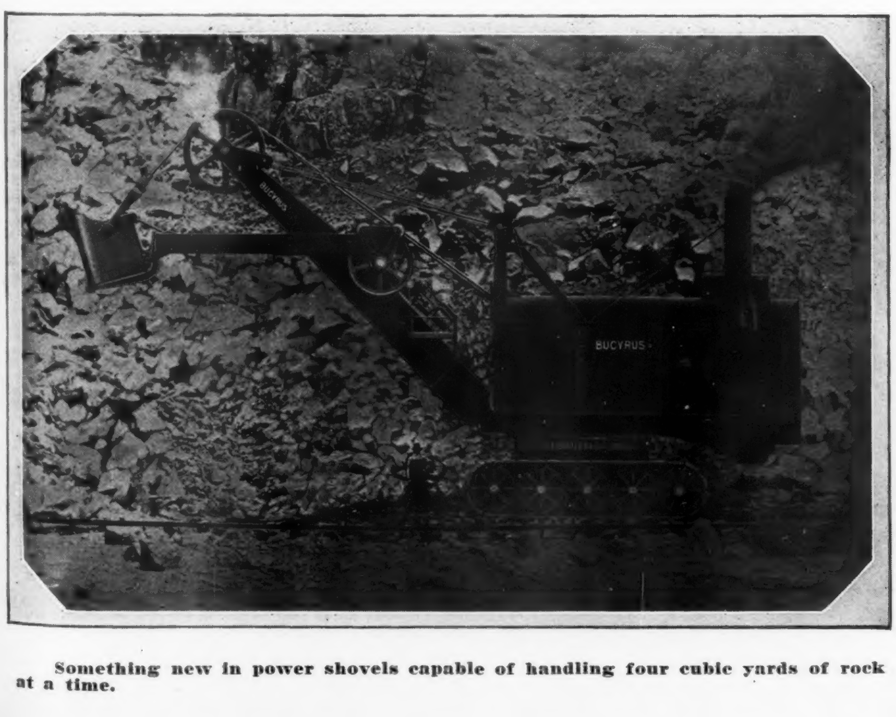
WHERE THE WORLD GETS MOST OF ITS AMBER

AMBER, now so much in vogue for beads and ornaments, has been popular since the days of the ancients—in fact, it was an important article of trade between the Phoenicians and the inhabitants of the Baltic region, where amber is found. This petrified resin, which oozed from coniferous trees many thousands of years ago, is washed up all along the coast of Samland, East Prussia; but the chief source of the world's supply is Palmnicken, also in East Prussia, where amber is mined at a depth of from 66 to 99 feet.

Since 1899, the mining of amber has been a state monopoly—the rights to the raw product having been sold to East Prussia by a Königsberg firm for the sum of $4,000,000. At the state amber works, in Königsberg, the stone is cleaned and sorted and sold chiefly to manufacturers in Germany and Danzig.

For a number of years Danzig has been the principal source of amber beads and ornaments—the annual output being valued at from $250,000 to $300,000 annually. Very little if any of the raw material is lost in manufacture, that is, the waste particles are made into blocks by a special process which employs heat and pressure. Amber in this form can be worked up like the genuine article.

Much of the amber jewelry turned out in Danzig goes to India, Turkey, Asia, Japan, China, and Jerusalem; and in the latter place amber beads are often used for rosaries. In Africa the natives are partial to necklaces of genuine amber beads as large as a man's fist—ivory and rubber usually being received in exchange.



Something new in power shovels capable of handling four cubic yards of rock at a time.

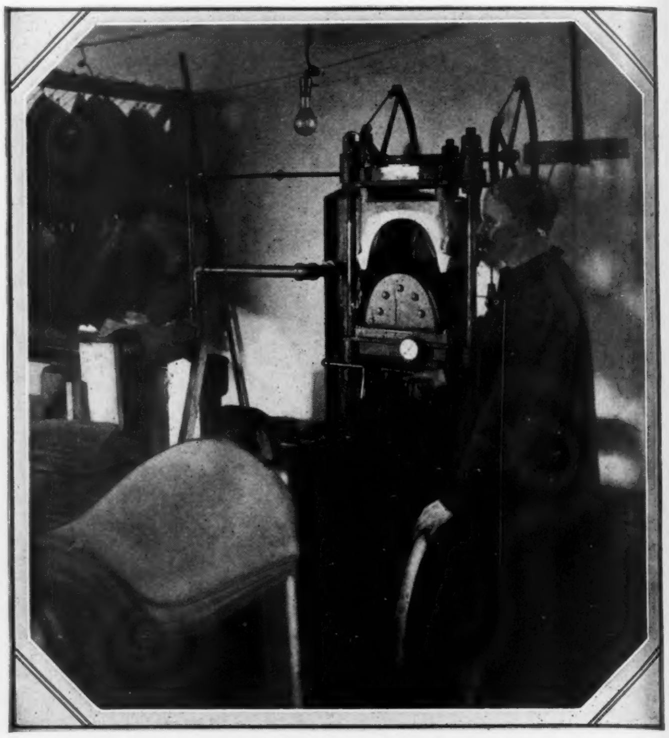
COMPRESSED AIR IN NEW FIELD OF SERVICE

THE old method of producing leather leggings was to form them over a block. Forms of that sort took up considerable space and resulted in a very costly and an inefficient way of shaping leggings. It was necessary for the operator to thoroughly saturate the leather before tacking it down on this block; and then the form had to be set aside a day for drying. Next, the leather was taken off the form and trimmed.

Today, in modern plants, air-operated presses and dies are used, and these have increased by 50 per cent. the capacity per man per day. A good workman can turn out 300 forms daily. This new method not only eliminates wastage in trimming but it also produces a closer grained legging and gives it an ideal shape which will be retained for a much longer period than if made as formerly by hand. Leggings fashioned in the old way had a tendency to straighten out in a short time and to lose their form. This was probably due to the fact that the leather, before putting it on the wooden block, was thoroughly soaked and did not receive the forming pressure of 125 pounds per square inch now employed in the presses.

By the new method the outside of the legging is given a finished appearance and can, therefore, be stained and polished very easily. In the case of the old procedure, however, the inside of the legging had this finish and it was necessary afterwards to go to the extra trouble to provide it with a good external finish. After the puttees are stained, buffers are used to give them the final polish. The leggings are then bound around the edges, and the needful straps for fastening are attached.

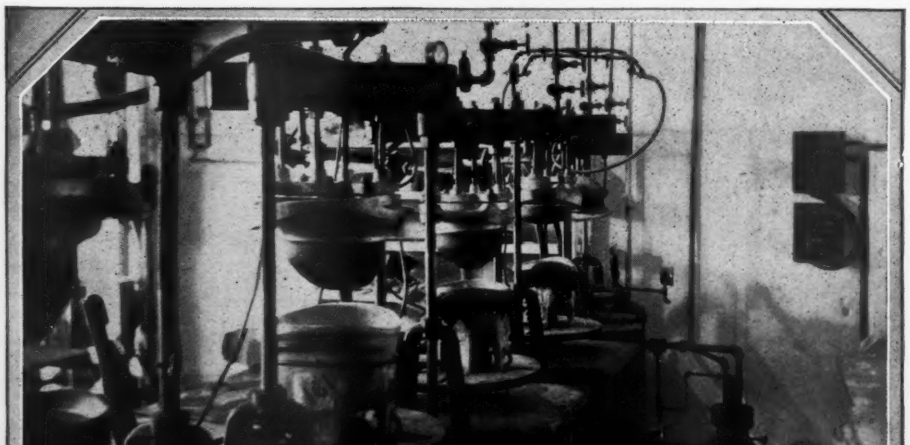
An accompanying picture of one of these presses shows the upper head or die, which is heated by gas, and the lower forming blank which has a rubber diaphragm. Inside of this diaphragm is a core through which the compressed air is distributed. The leather is placed in this form and the two dies brought together by the lever at the right. Air is then admitted by means of the little valve on the front of the machine. It is interesting to note that the messenger boys of the Western Union Telegraph Company were not provided with leather puttees until the pneumatic-press system was perfected. This system has reduced the cost of these leggings from $15 to $3 a pair.



Air-operated press which shapes leather puttees so that they will conform to the wearer's legs. An Ingersoll-Rand Type Fifteen compressor furnishes the air that works the machine.

Air-operated presses and dies are also used in forming felt hats and any woven grass hats that have elasticity. The old-fashioned method of doing this was somewhat similar to that formerly employed in making leggings—that is, the hats were put on wooden forms and finished by hand with hot irons. The new process produces a much more satisfactory article. In the manufacture of velour hats, air guns are used to blow the hair up, and this hair is then trimmed by the aid of compressed air or by mechanically operated clippers.

At the New York plant of the Marion Hat Works there are six pneumatic hat-blocking machines operated by air furnished by a 3x3-inch Type Fifteen compressor. It is possible for one man to attend to all six of these machines. For the purpose of forming puttees, the Peerless Legging Company has one pneumatic legging machine in its New York plant, and air to run it is provided by a 4½x5-inch Type Fifteen compressor.



Pneumatic hat-blocking machines which give the felts their fashionable shape. Air for this purpose is supplied by the small electrically driven compressor seen on the floor at the right.

SHARP SAND NOT ESSENTIAL IN SAND BLASTING

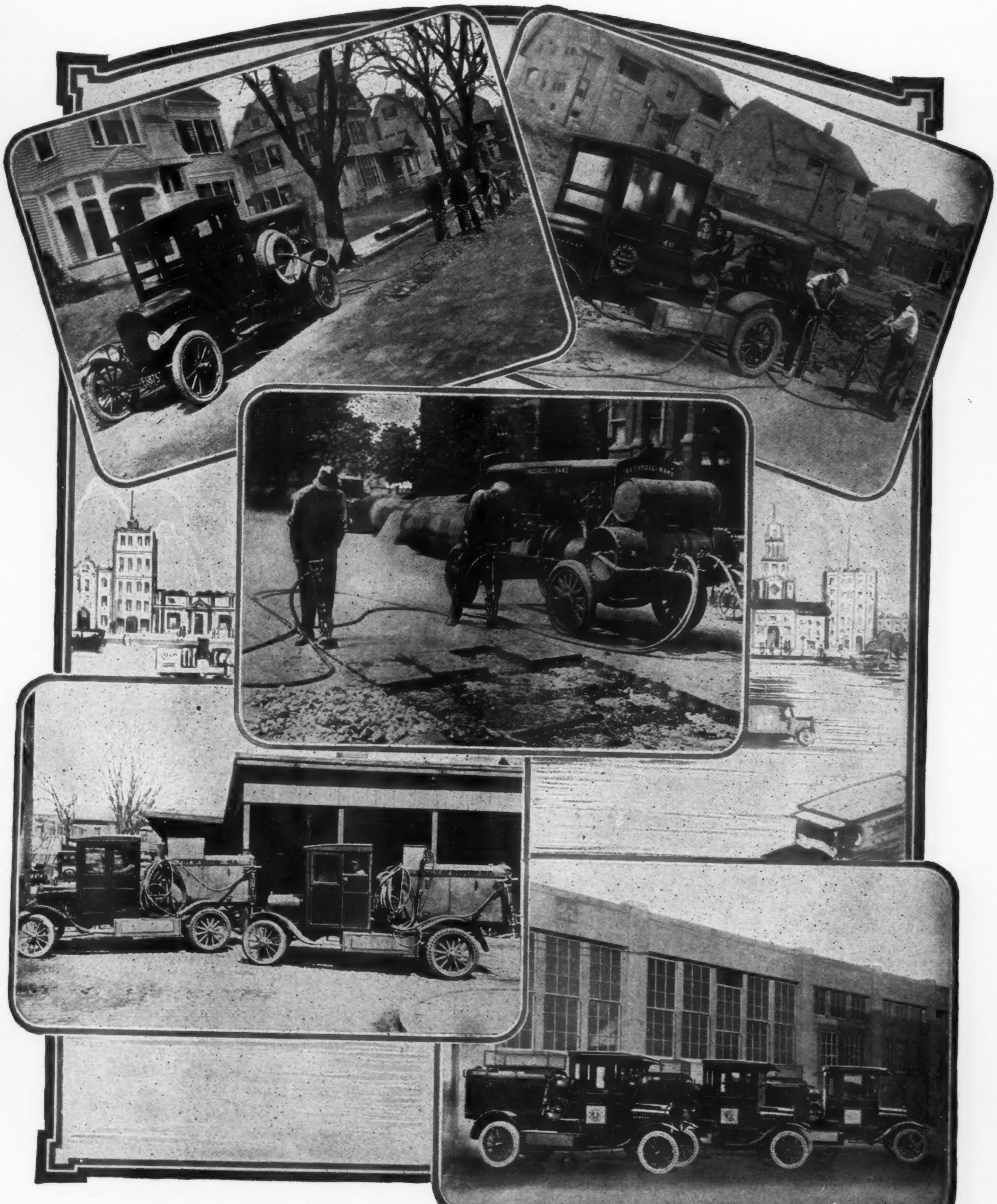
GRAINS of sand are merely minute pebbles, and have similar characteristics. They are fragments of rock broken off in the constant erosion of things. When newly broken they are, of course, sharp and angular, but when rolled about for ages the sharp projections are worn off and the surfaces become rounded.

From what has been considered the common-sense point of view, it has been reasoned out that sharp sand must be the more effective for sand blasting; but extensive experience in cleaning castings, in restoring the surfaces of brick and stone buildings, in carving and engraving, in putting the final finish on metal surfaces, etc., it has been found that the sharpness of the sand counts for little in producing the desired result. What is more essential is hardness in the sand particles.

Pure silica sand, or sand composed of grains of quartz, is much better than sand containing mostly grains of feldspar or iron oxide. It does its abrading work more effectually; and, as the material is generally used over and over again, it is not reduced as readily to fine dust and therefore lasts longer.

Railroads in the United States own or control 125,000 refrigerator cars.

Typical Applications of Portable Air Compressors In Public-Service Work



Compressed Air for the Gas Furnace

By C. A. DAWLEY*

THE combustion of gas requires a supply of air many times the volume of the gas burned. There are several ways of bringing the gas and the air together—the oldest and the best known of these being the one used in connection with the Bunsen burner and such familiar domestic appliances as the gas stove, etc. In these "atmospheric" burners, the pressure under which the gas supply is furnished causes the gas to issue in the form of a jet from a small opening. This jet is directed into the open end of a tube so that air may enter the tube with the gas and be drawn along to the burner outlet by the velocity of the gas. This method is suitable for low-temperature work; but it is not adapted to give the high temperatures required in most industrial furnaces because, in the first place, the velocity of the gas is not sufficient to induce the flow of enough air for complete combustion, and, in the second place, the pressure at the burner head is so low that the flame must be very large in order to burn sufficient gas.

Ordinary illuminating gas, such as is supplied by gas companies, has a heating value of from 500 to 600 thermal units per cubic foot and requires about 6 feet of air to burn 1 foot of gas. The Bureau of Standards, which has conducted exhaustive tests on atmospheric burners, has found that well-designed burners of this type will induce a flow of from 2.5 to 4 feet of air per foot of gas when the gas is supplied at the usual pressure, which is equivalent to a 4-inch water column. This is not enough air for complete combustion, and the balance must be obtained by putting the flame in contact with additional free air.

As previously mentioned, atmospheric burners are not suitable for most industrial furnaces where high temperature is needed in a contracted space. For this service the blast burner has been generally adopted. This type of burner requires the mixture of gas and air to be under a relatively much higher pressure than that in the atmospheric burner. In the blast burner, the pressure may run up to that of a 7- or an 8-inch water column so as to give a short intense flame of high temperature, which, incidentally, is essential to maximum furnace efficiency. The several methods commonly employed to obtain a mixture of air and gas of correct proportions and under sufficient blast pressure are divided into the following four classes: the low-pressure air system; the high-pressure gas system; the premixing system; and the high-pressure air system.

In the low-pressure air system, which is probably the one most commonly used, the air is compressed by a blower—usually of the positive or rotary type—to a pressure varying from one to two pounds per square inch. This pressure is then reduced in passing through the so-called "tin-injector" or low-pressure nozzle which is inside the tee fitting where the air and gas come together. The action of the injector creates a suction and causes the gas to flow into the mixture pipe, where the pressure is sometimes above and sometimes below that of the gas in the supply pipes. For each furnace or group of furnaces, this system requires the installation of a positive blower, together with a belt or motor to drive it, and of a tank and a relief valve to control the pressure and the volume of air delivered. It will give satisfactory results in the furnace provided the pressure of the gas as supplied is sufficient to induce the necessary flow of gas. Trouble in obtaining full furnace capacity is generally due to deficient gas pressure caused either by friction losses in the main or by connecting too many furnaces to one gas supply.

In the high-pressure gas system the gas is usually compressed to a pressure of from five to ten pounds per square inch. When used in an injector, this is sufficient to induce a flow of air ample enough to insure combustion. The chief advantage of this is that only one-sixth as much volume has to be handled by the pump as when all the combustion air is compressed. The power needful is somewhat less than that used in the low-pressure air system; and the difficulty with inadequate gas-supply pressure is overcome. A special pump with its accessories is required for each furnace or group. The chief disadvantage lies in having the gas under considerable pressure, thus running the danger of leaks especially in the stuffing boxes of the pump.

Large oven, installed in a forge shop, arranged to operate with high-pressure-air system.

In the premixing system all the gas and part or all of the air required are mixed together and slightly compressed, usually by a fan, to a pressure of a few ounces per square inch or to a little more than the burner-head pressure at which the furnace operates. The premixing system is economical in power; permits good control of the mixture; and is seldom affected by insufficient pressure on the gas supply. It calls for a special installation for each furnace or group of furnaces, and introduces the possibility of explosion in the piping carrying the mixture of air and gas from the fan to the furnace.

The high-pressure air system takes its energy from a supply of compressed air which is usually available—that is, in most shops or factories where gas furnaces are in use compressed air need not be provided especially for the purpose. Compressed air is sometimes employed, on account of its convenience, to operate furnaces on the low-pressure air system; but in that case the air is reduced from high to low pressure by passing it through a reducing valve or a plain throttle valve. This is an objectionable practice, because most of the power in the compressed air is wasted in reducing the pressure. There is also the possibility of forcing air backward into the gas line

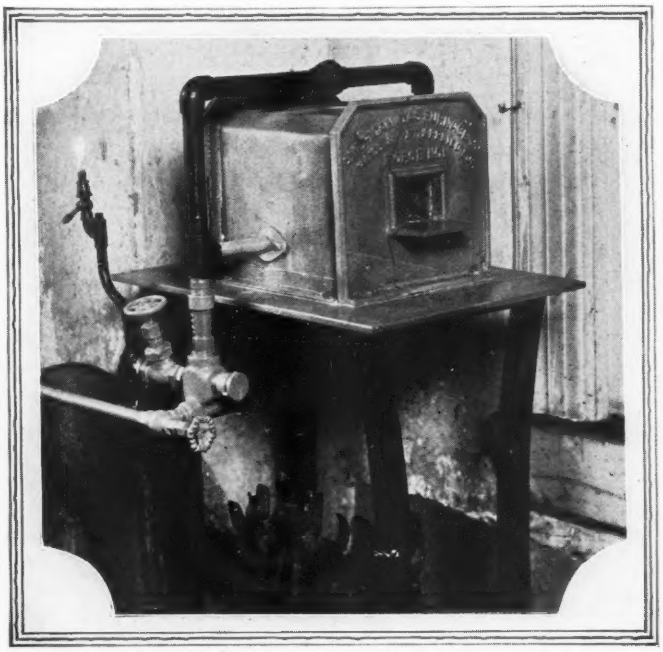
*Chief Engineer, New Jersey Meter Company.

and creating an explosive mixture. Many gas companies prohibit this practice.

In the true high-pressure air system only a small percentage of the air necessary for combustion is taken from the air line. This is used to operate an induction blower which provides 90 per cent. or more of the air required and also creates a suction on the gas. The gas flows into the blower at a point where the pressure is always below atmospheric pressure, and no difficulty is therefore experienced with insufficient gas pressure. The air-and-gas mixture, after passing the Venturi throat of the blower, gradually decreases in velocity and increases in pressure—giving any desired pressure at the burner head. The blower is attached directly to the furnace so that there is no piping carrying an explosive mixture other than that by which the mixture is fed to the furnace itself. The air line is of small diameter—for example, a ¼-inch pipe is sufficient to operate a furnace which would require 2-inch piping with the low-pressure air system. The air supply, both direct and induced, is controlled by one small needle valve. No motor nor belt drive, in fact no moving machinery is needed in connection with the furnace, itself, when air is furnished by a compressor already installed. A compressor provided for the sole purpose of operating furnaces is relatively small in size and can easily be connected to a considerable number of furnaces even if they are widely scattered through the plant.

The accompanying sectional cut shows one form of induction blower used in the high-pressure air system. Compressed air is admitted by a needle valve to chamber C, where screen S removes any particles of solid matter, such as pipe scale or rust. The air then issues at high velocity through the orifice of jet nozzle N. This creates a suction in space B, thus drawing in gas through pipe G and free air through the opposite opening. The free-air opening is provided with an air cap, A, which may be closed to prevent an escape of gas while lighting the furnace. The air and the gas are forced through throat T of the Venturi mixture tube M by the energy of the jet issuing from nozzle N. The outlet of the mixture tube is connected to the piping on the furnace.

Broadly speaking, any gas furnace may be worked by any one of the four systems described.



Small gas furnace equipped for high-pressure-air system and used in a tool room for hardening and tempering.

There is practically no difference in the furnaces operated in these various ways, and any furnace can readily be changed over from one system to another. Without considering the means employed to feed the gas and air, efficient furnace operation depends not only on an ample supply of gas and the proper proportion of air to burn the gas completely but also on getting the highest possible flame temperature. It is interesting to note that the heating value of various gas mixtures, as shown in the following table,* is about the same, regardless of the heat value of the gas itself.

	B. T. U. per. cu. ft.	Air required per cu. ft. gas	B. T. U. per cu. ft mixture
Natural gas, Pennsylvania	1,120	11.7	88.3
Manufactured coal gas	570	5.64	86 0
Coke-oven gas ...	538	5.28	85.6
Water gas	288	2.32	86.8

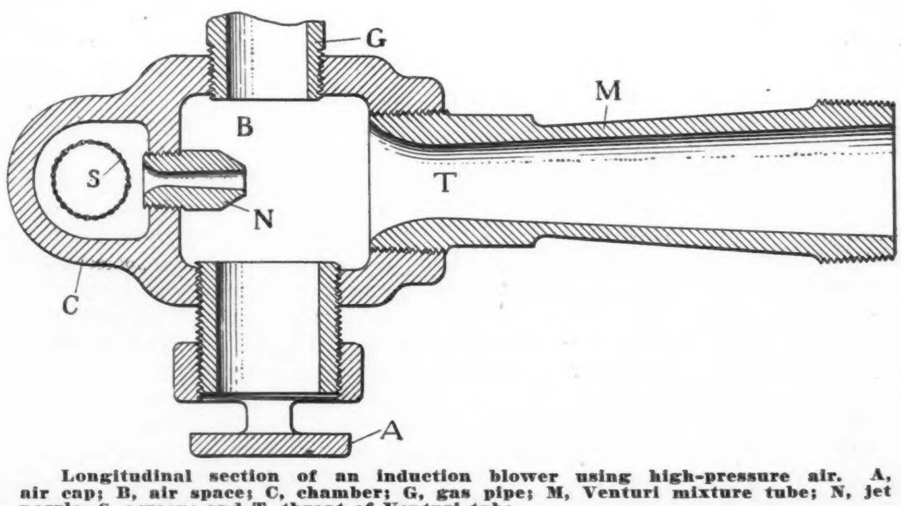
It is apparent that the heating value of a cubic foot of a properly proportioned mixture of gas and air is not dependent on the richness of the gas; and it is true that as high a temperature can be obtained from water gas as from the richest natural gas. After securing a proper mixture, it is important to see to it that the orifices or openings at the burner head be of suitable size to accommodate the volume of the mixture being burned. A practical basis upon which to approximate burner openings is 1 square inch of orifice area for 50 feet of mixture per minute or 3,000 feet of mixture per hour. This should be based on the maximum rate of combustion for the furnace, and corresponds to a burner-head pressure of a water column of about 5 inches. With average illuminating gas, and upon the same basis, 1 square inch of burner orifice area should be allowed for 500 feet of gas per hour. Burners so proportioned make it possible to obtain the highest flame temperature and the maximum furnace efficiency. If burner openings are too small it is impossible to burn sufficient gas for maximum capacity and, on the other hand, if they are too large the burner pressure will be low and the flame will be less intense.

JAPAN'S HYDRO-ELECTRIC RESOURCES

ABOUT one-half of Japan's possible hydro-electric resources—totaling nearly 6,000,000 kilowatts—has been developed, according to the latest available data. As the rivers of Japan are short and have small drainage basins and a variable flow, there is some question as to the practicability of certain of the remaining sites.

A recent drought throughout central Japan, threatening a shortage of water power, has so alarmed the existing hydro-electric companies that many of them are constructing or considering the construction of auxiliary steam plants. It is unofficially estimated that steam auxiliary plants, having a total capacity of 230,000 kilowatts, are now being built in central Japan; and applications have been made for permission to erect power houses capable of producing another 216,000 kilowatts of steam-generated electricity.

Cigarette smoking in China is a habit fairly recently acquired, and began in a small way about 1890. The total imports for 1923 amounted to about 10,117,000,000 and, according to *Commerce Reports,* exemplify the luxury purchasing power of a people with a low per capita wealth.



Longitudinal section of an induction blower using high-pressure air. A, air cap; B, air space; C, chamber; G, gas pipe; M, Venturi mixture tube; N, jet nozzle; S, screen; and T, throat of Venturi tube.

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EDITORIALS

THE BUILDING BOOM

IT is likely that a large part of the prosperity in the United States during the past two or three years has been due to the enormous increase in building activities. Total building contracts, awarded during 1924 throughout the entire country, are estimated at $5,000,000,000. In New York City alone the contracts in 1924 amounted to $879,000,000.

The year 1925 started in January with building contracts higher than those for any previous January. In February, following, the total was only half that of February a year ago. This decline continued in March—contracts being only $57,000,000 as against $131,000,000 for March, 1924.

This boom is the natural result of a building-construction shortage during the war, but it cannot continue indefinitely. The extraordinary activity in building not only maintained but increased the high level of wages paid in factories. It has been the means of giving employment to a large number of men at high wages, of stimulating industry in all kinds of building materials, such as lumber, steel and iron, cement, copper, lead, etc.

Will the falling off in the building industry create a reaction in business? Activity in this line usually records high prosperity in business, and building depression has usually shown a corresponding decrease in general business. The saving factor seems to lie in the fact that this recent business activity has not been accompanied by an overhead expansion of high bank loans, nor a great rise in prices. Commodity prices have risen largely because farm products have risen from a point where they were out of proportion to the prices of other basic commodities.

There is at present no evidence of capital or money or credit stringency. In other words, the boom in the building trade has not carried with it inflation; and in this there may be the hope, and, perhaps, the reason why a falling off in building may not be followed by the usual falling off in general business.

W. L. S.

THE VON HINDENBURG SURPRISE

NO little concern has been felt over the fact that Germany has recently elected a military idol to the presidency. History shows that, following a war, the people usually reward through suffrage men who have figured conspicuously in battle. In 1871, THIERS—known as the saviour of his country—was superseded by the election of a royalistic soldier, General MACMAHON. JACKSON was elected to the presidency through his military record in our wars with Mexico. GRANT, after the Civil War, could not be defeated—serving two terms in the presidency and almost winning the nomination for a third.

HINDENBURG's election follows the conservative wave that has recently swept over the world. It was shown here in the defeat of LAFOLLETTE. It was shown in France by the defeat of HERRIOT, in England by the recent defeat of the labor party. The election of COOLIDGE was a conservative victory.

Germany needs capital. Bank loans there, outside of the larger corporations, run at the rate of about 15 per cent., including commissions. The discount rate at the Reichsbank is 9 per cent. Wages are very low. The average earnings of German workmen are now officially given as the equivalent of $9.50 per week, when based upon gold marks. This is less than many skilled workmen get per day in the United States; and it has been estimated that the average wage in the United States is from three to four times greater than that in Germany.

The cost of living in Germany is now 35 per cent. above the pre-war level—based upon gold. In America it is 70 per cent. above, but wages here have followed the increase in living expenses while in Germany they are but a little higher than they were before the war.

When we consider the collapse of German currency following the war, and the demoralized condition of her finances, it is much to the credit of the German people that there should be so great an improvement indicating a steady recovery. The conservatives now being in power through the recent election, it seems reasonable to expect that in matters of taxation the workers are likely to be burdened to a greater extent than had previously been contemplated, for Germany must raise large sums of money to make reparations payment under the DAWES plan.

W. L. S.

SELLING ON LONG-TERM PAYMENTS

IT seems well at this time to introduce a word of caution about the policies of certain corporations and individuals in America to sell goods on long-term payments. This policy has been adopted to an extraordinary degree in the automobile trade. Discount corporations and others make a business of encouraging purchases on long-term payments covering periods of from three to five years—money being borrowed at the banks for this purpose and the customer being charged usually 5 per cent. on deferred payments.

Such a situation is all well and good when business is moving upward, when money is at a low rate in the country, when credit is not strained, and when buying power is greater than the supply. But such business necessarily involves an expansion of capital and credit. It is pyramiding on a dangerous scale. In the long run, judging by our experience in the past, we are sure to meet periods of depression, of over-production, of inflation, or periods like the so-called recent "buyers' strike." When goods are thrown on the market, prices fall; money rates go up; payments cannot be made; banks call their loans for their own protection; business becomes paralyzed; men fail to get work; and receiverships abound.

It is an old and a wise adage that, if one wants business stability and safety, one should pay as he goes and if he cannot pay he should not go.

W. L. S.

ACTION PROMISED ON ST. LAWRENCE PROJECT

ANOTHER step is soon to be taken looking toward the solution of the problem to link the Atlantic Ocean with the Great Lakes by a deep-water channel in the upper stretches of the St. Lawrence. The United States and Canada have agreed on an engineering board to be composed of three American and three Canadian engineers; and these experts will review the previous joint plan offered a few years ago and fix the terms for a complete survey of the St. Lawrence project.

The board will report on the feasibility of digging a 25-foot channel between the points where locks will be interposed. It has been estimated that the complete undertaking will call for an expenditure totaling $300,000,000; and, according to the terms under which the board is organized, it is called upon to submit its report by April 30, 1926.

The pros and cons of this vast scheme, which will involve the drilling and blasting of enormous quantities of rock, have been pre-

sented in our pages in the past; and there is no denying that many millions of people and a very large inland section of the United States are earnestly desirous that this route to the sea shall be provided. We shall look forward with great interest to the outcome of the board's study of this momentous subject, in which compressed air must ultimately play a prime part should the work be taken in hand.

DO YOU KNOW?

IN this manner the United States Post Office Department heads an appeal to the general public designed to lessen carelessness in addressing and in wrapping mail matter. And, to drive home the consequences of indifference or neglect, points out that 21,000,000 letters and 803,000 parcels went to the Dead Letter Office last year; that 100,000 letters go into the mail annually in perfectly blank envelopes; that $55,000 in cash is removed every twelvemonth from misdirected envelopes and that $12,000 in postage stamps is found in similar fashion; that $3,000,000 in checks, drafts, and money orders never reach their intended owners; that Uncle Sam collects $92,000 a year in postage for the return of mail sent to the Dead Letter Office; and that it costs the Government—therefore the public—$1,740,000 annually to look up addresses on misdirected mail—200,000,000 letters requiring this service.

These losses could be avoided and the Dead Letter Office abolished if each piece of mail carried a return address, and if each parcel were wrapped in stout paper and tied with strong cord.

We announce with regret the death recently of Mr. John J. Smith of the Ingersoll-Rand organization. Mr. Smith started as a timekeeper with the A. S. Cameron Steam Pump Works in June of 1903, and remained with that company until May of 1912, when he became part of the personnel of the Ingersoll-Rand Company at 11 Broadway, New York City. He was in charge of the supply room until his demise.

Mr. Smith was one of New York City's most prominent oarsmen 50 years ago. He is survived by his widow, two sons, and three daughters.

An international industrial exposition will be held at La Paz on August 6 in connection with the celebration of the Bolivian Centennial of Independence. The Bolivian Government, through its legation in Washington, D. C., extends a cordial invitation to American machinery manufacturers to participate in the exhibition and has arranged for duty-free importation of exhibits, adequate space for the erection of pavilions, and a reduction of freight rates on products shipped for exhibition purposes. Further information regarding the exposition may be had by addressing the Bolivian Legation.

BOOK REVIEWS

THE METALLURGY OF ALUMINUM AND ALUMINUM ALLOYS, by Robert J. Anderson, B.Sc., Met. E. This is an illustrated volume of 913 pages, published by Henry Carey Baird & Co., Inc., New York City. Price, $10.

ALUMINUM is one of the wonder metals of present-day industry, and the things made possible through aluminum alloys are no less spectacular and valuable. The book is a comprehensive treatment of this important subject, and carries the reader all the way from the mining of bauxite to the uses and applications of the metal and its alloys. In short, it fills a rather pressing need; and the volume should be of great help not only to metallurgical engineers and foundrymen but likewise to automotive and mechanical engineers. The treatment is clear and designed to render the information of practical aid, although the theoretical aspects of the topic have been well taken care of.

THE ADVERTISING YEARBOOK FOR 1924, edited by John Clyde Oswald. A work of 489 pages, published by Doubleday, Page & Co., Garden City, N. Y., for the Associated Advertising Clubs of the World. Price, $2.

THIS book is a compendium of the papers read and the addresses made during the convention held in London, England, last year; and it presents a vivid picture of the present-day meaning of advertising and the spirit in which this great work is being carried on the world over. It is not possible here to consider in detail the various aspects of this field of service touched upon so admirably during the convention, but anyone interested in advertising in any way should profit by a reading of the yearbook.

THE COAL INDUSTRY, by A. T. Shurick. An illustrated book of 383 pages, published by Little, Brown & Co., Boston, Mass. Price, $3.50.

THE author's purpose in the writing of this volume has been to supply a standard work which would cover the whole field of the coal industry from the very beginning of the use of coal as a fuel down to the situation dealt with in the latest report of the United States Coal Commission.

The primary value of the volume is largely due to the fact that it draws together from a variety of sources not easily available for research a multitude of facts about an industry that concerns directly or indirectly virtually everyone of us. Furthermore, the author has made his pages well worth while by the skill displayed in rendering understandable to the general reader a subject which naturally bristles with complications and technicalities. We are informed that no other book so comprehensively covers the whole field of coal from the mine to the consumer.

GASOLINE, by T. A. Boyd, head of the Fuel Section, General Motors Research Corporation. An illustrated work of 211 pages, published by Frederick A. Stokes Co., New York City. Price, $2.50.

THE mention of gasoline or "gas," as the motorist popularly dubs it, brings instantly to mind the 17,000,000 and more automotive vehicles which now speed back and forth over our streets and over our highways throughout the length and breadth of this expansive land of ours. Therefore, the story of gasoline should be of much interest to a very considerable percentage of the populace.

What gasoline is, where it comes from, what its properties are, what distinguishes good gasoline from bad and, most important of all, how the motorists can get more miles out of a gallon and therefore help in the very necessary economy of this important fuel—are some of the angles of the subject that are vividly described by Mr. Boyd who, for years, has been a leader in research and development work having to do with motor fuels.

Specific heat of superheated ammonia vapor is the title of a pamphlet recently issued by the United States Bureau of Standards, and is to be had for fifteen cents upon application to the Superintendent of Documents, Government Printing Office, Washington, D. C. The pamphlet is the result of the joint labors of Messrs. N. S. Osborne, H. F. Stimson, T. S. Sligh, Jr., and C. A. Cragoe.

Westinghouse apparatus for marine application. This illustrated book of 528 pages contains much valuable information and many useful notes on navigation and seamanship, together with data of interest to marine engineers. This valuable volume is for free distribution and can be obtained by applying to the Westinghouse Electric & Manufacturing Company, 150 Broadway, New York City.

What is said to be the tallest smokestack in the world is located at Anaconda, Mont., in the reduction works of the Anaconda Copper Mining Company. The stack is over 585 feet high and has an inside diameter of 75 feet at the base and 60 feet at the top.

Montreal's facilities for handling grain now make it possible for 23 ocean-going vessels to be loaded simultaneously at the rate of 450,000 bushels an hour. At the same time, 150,000 bushels can be unloaded every hour from lake boats and 125,000 bushels from railway cars. In other words, 725,000 bushels of grain can be handled in an hour—that is, at the rate of 350 tons a minute.

At Independence, Kansas, bricks were laid in pavements 17 years ago at a cost of $6 per 1,000. When taken up recently, to make way for new paving, the bricks sold for $7 a thousand.

Motor buses for passenger traffic are becoming more and more popular both in Canada and in the United States where a total of 53,000 were in service in 1924.

AIR-OPERATED FOG HORNS

THE fog horn or siren plays an important part in guiding the navigator during periods of thick weather. Each siren has a distinctive signal by which it can be orally identified by the man on the bridge. This is essential, especially in confined and much used waterways where several sirens may be installed to help the mariner hold to a safe course. It is a common practice to employ compressed air to sound the warning blasts; and the United States Lighthouse Service has experimented extensively in its efforts to obtain thoroughly satisfactory and reliable apparatus of this sort. We are indebted to the Service for the following particulars about one of the latest of these navigational aids.

The accompanying photograph shows a standard, automatic, 6-inch siren equipped with a vertical trumpet having a horizontal, flared mouthpiece. Attached to the side of the siren is a quick-opening valve for admitting the sound-producing compressed air to the trumpet. This valve is controlled by a rod which, in its turn, may be actuated by the piston of one or the other of two small upright cylinders secured to the vertical bedplate of the apparatus. These pistons are operated by compressed air; and the opening and closing of the associate air valves are timed by the movement of two cams which revolve once a minute and are driven by clockwork. The form of the cams determines the "characteristic" of the siren—that is, the number and the length of the blasts sounded every 60 seconds.

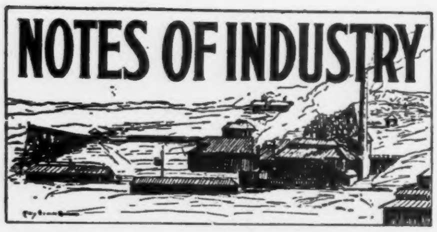
After each blast, the piston that has induced that blast is pulled back to the starting position by a long spiral spring, and the exhaust air is discharged into the atmosphere. An extension of the piston rod passes up through the top of each cylinder, and during the upward travel of the rod it throws a lever and winds the clockwork. In this way, the clockwork is rewound continually while the siren is in action.

Air for the siren can be furnished by an air compressor driven either by an internal-combustion engine or an electric motor—the air being delivered to one or more receivers from whence it is piped to the different parts of the apparatus. The air in the receivers is maintained at a prescribed pressure, and is ready to supply the siren the moment weather conditions require the horn's operation. As a result, there is no lag or failure of service while the compressor is being brought up to full speed. Air is delivered to the siren at a pressure ranging from 35 to 40 pounds per square inch.

In cold climates, the compressed air—after leaving the receivers—is sometimes warmed by being passed through a reheater before it reaches the siren. The reheater is kept hot by the exhaust gases from the driving engine. To guard against breakdown, and to insure service at all times, the plant is in duplicate; and this means a second trumpet, as well as a reserve compressor, engine, etc.

© Ewing Galloway, N. Y.

Compressed air siren for fog signaling.



Never before have the national parks been more popular with the American people than they are now. Ten years ago the visitors numbered less than 250,000. During the 1924 season more than 1,600,000 people visited the parks, and about 70 per cent. of these toured the reserves in their own automobiles. This is an indication of what good roads are doing towards increasing the popularity of the government playgrounds.

It is reported that the Anglo-Canadian Collieries & Refineries, Ltd., has acquired the Canadian rights for a German process for extracting the bitumen from tar sands. This company is soon to begin operations looking towards the exploitation of the Northern Alberta tar sands.

The huge graving dock which has been under construction at Esquimalt, British Columbia, since 1921, is rapidly nearing completion. The basin is cut out of solid rock; it is 1,150 feet long; 149 feet wide at the top and 126 feet wide at the bottom; 49½ feet deep; and has 40 feet of water on the sills at high tide.

One of the mechanical improvements in the enameling industry that has speeded up production to a marked extent is the continuous spraying system. Instead of handling the pieces separately they are placed on a belt or cable conveyer and passed through a booth, where the enamelware is sprayed in transit. The work of spraying is usually done by compressed air.

It may interest some of our readers to learn that Jenkins Brothers, New York City, manufacturers of valves and mechanical rubber goods, have purchased the good will of H. A. Rogers Company, also of New York. Jenkins Brothers now have the sole right to manufacture Moncrieff Scotch gage glasses in the United States.

By means of a new type of instrument, called the fabric tension meter, it is possible to measure the tension of aircraft fabrics in place—that is, when only one side of the cloth is accessible, as in the case of the gas bag of an airship or the wing of a flying machine. The instrument consists of an open chamber, having an elliptical cross section, which is provided with a pressure gage and a deflection meter. The edge of the chamber has a series of suction holes so that a certain area of the fabric can be isolated. The pressure required to produce a given deflection enables the investigator to calculate the tension.

According to the United States Department of Commerce, the electric street railways of the United States, in 1922, generated 6,440,380,325 kilowatt-hours and purchased 5,926,421,203 kilowatt-hours—an aggregate of 12,366,801,528. Approximately one-quarter of this current was sold for power and lighting purposes. It is estimated that the total for 1923 amounted to 56,000,000,000 kilowatt-hours or, say, 75,000,000,000 horsepower-hours.

A new illuminating gas has been announced which is said to possess unusual virtues. It is the product of a process invented by Dr. O. U. Bean, inventor of the Bunsen furnace and a recognized authority on all that concerns the manufacture of gas. The gas is claimed to be non-asphyxiating; to have double the heating value and candle power of ordinary manufactured gas; and can be produced at a much lower cost. It is made either from oil or from refinery residuum—a waste product. Its non-asphyxiating quality is attributed to the fact that "it is composed largely of hydrogen and carbon combinations."

The gathering and the storing of natural ice along the Hudson, except for strictly local use, have become insignificant. Last winter was an exceptionally good one for ice harvesting on the river, but the business no longer pays. It is said that the great manufactured-ice companies of New York City have plant and storage capacities sufficient to take care of the heaviest demand; and they provide better ice while eliminating the cost of transportation and the maintenance of immence ice houses.

According to a recent survey, more than half of the homes in the United States use electricity. Utah leads the states in this respect, with 98.2 per cent. of her private dwellings wired. Next come New York, New Jersey, and Pennsylvania, each with 53.3 per cent. of its householders enjoying the convenience of electric current.

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